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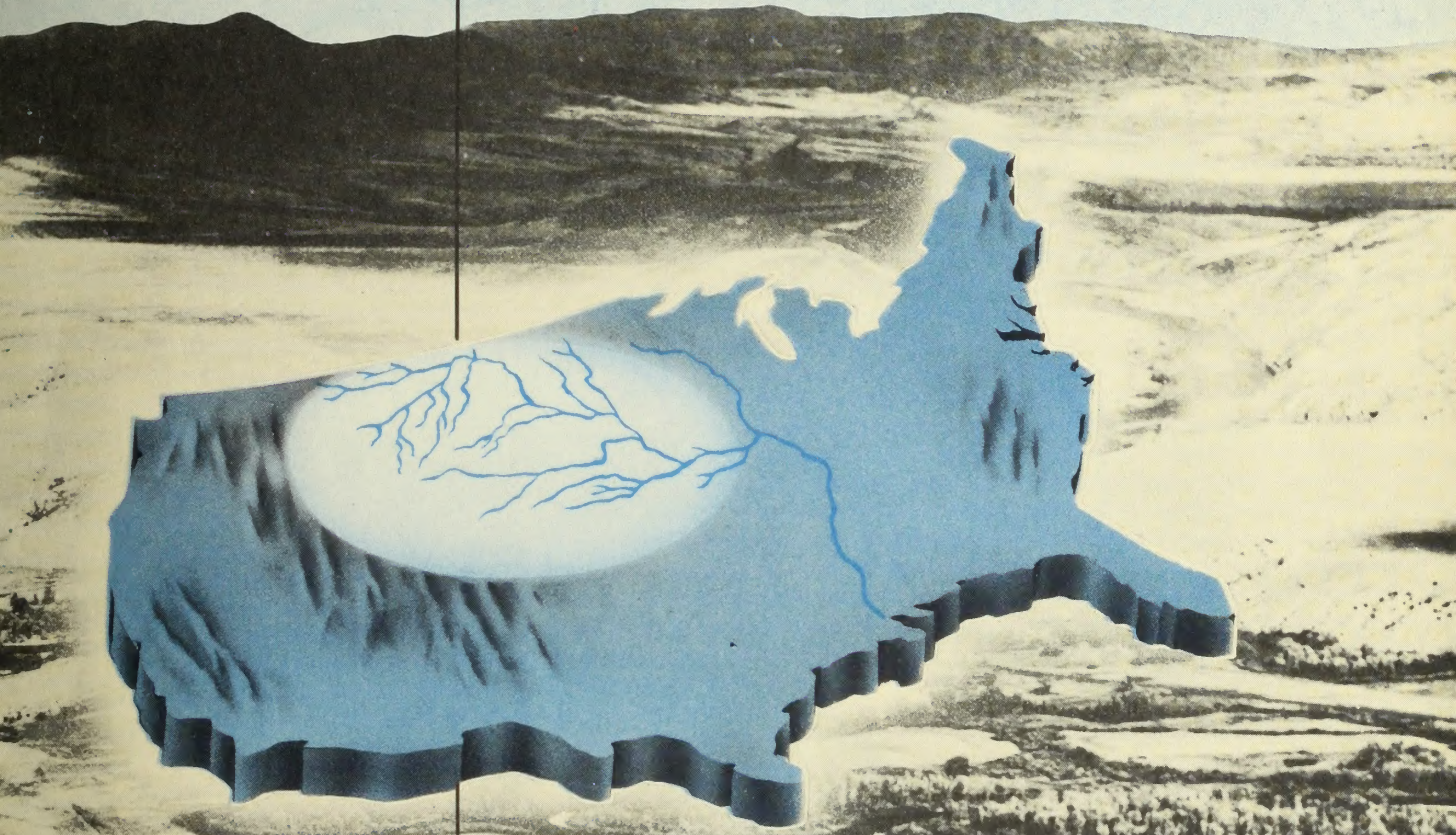

DEVELOPMENT PROGRAM

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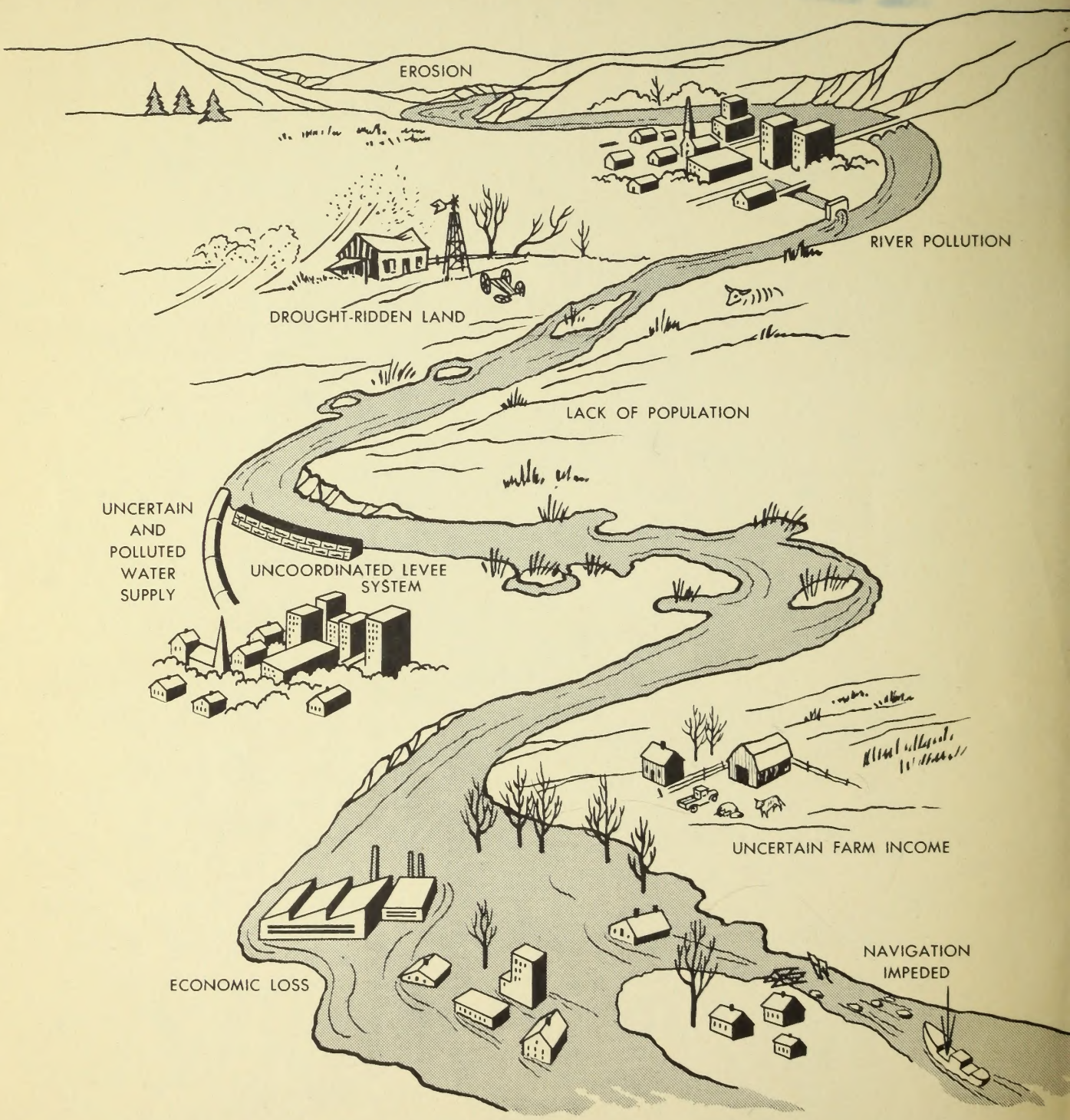

UNCONTROLLED, the energies of a river are wasted and destructive.

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THE MISSOURI RIVER BASIN DEVELOPMENT PROGRAM

Published by

The Missouri Basin Inter-Agency Committee

CORPS OF ENGINEERS, U. S. ARMY • U. S. DEPARTMENT OF THE INTERIOR
U. S. DEPARTMENT OF AGRICULTURE • FEDERAL POWER COMMISSION
U. S. DEPARTMENT OF COMMERCE • FEDERAL SECURITY AGENCY

and the

Missouri River States Committee

comprising representation from

MONTANA • WYOMING • COLORADO
NORTH DAKOTA • SOUTH DAKOTA • NEBRASKA • KANSAS
MINNESOTA • IOWA • MISSOURI

JUNE 1952

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TABLE OF CONTENTS

	Page
Foreword	3
The Missouri River Basin	5
The Background of the Program	7
The State Programs	10
The Missouri Basin Inter-Agency Committee	11
Costs of the Plan	13
Flood Control	14
Irrigation	17
Electric Power	19
Navigation	22
The Basin Land Program	26
Fish and Wildlife	30
Recreation	32
Water Supply	33
Public Health and Stream Sanitation	35
Mineral Resources	37
Industry and Business	39
Summary	42
Appendix A—Corps of Engineers Projects	43
Appendix B—Bureau of Reclamation Construction Units	44
Appendix C—Missouri Basin Power Plants	47
Appendix D—Population of the Missouri Basin	48

THE MISSOURI BASIN INTER-AGENCY COMMITTEE

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THE MISSOURI RIVER BASIN DEVELOPMENT PROGRAM

Foreword

IN the vast basin of the Nation's longest river there is today in progress a water and land resources development program which is the largest undertaking of its kind in history. Federal agencies and the 10 Basin States have joined to harness the Big Muddy and its tributaries and improve its watershed lands to gain multiple benefits for the people of this country's agricultural heartland.

Here, in a 529,000-square-mile region comprising one-sixth the continental United States, a multibillion dollar plan for the construction of reservoirs and other engineering features, together with the application of soil and water conservation measures, will yield benefits of flood control, irrigation, electric power, soil conservation, and navigation. There will also be related gains in the development of fish and wildlife, recreation, water supply and pollution abatement, forest and mineral resources, and business and industrial growth.

The ultimate objective to which the program will be continually adapted in response to changing conditions and needs is the full productive use of all resources of the Basin in a manner that will best meet Basin needs and make the greatest long-time contribution to the strength and progress of the Nation.

PROGRAM FEATURES

The program as now planned proposes:

1. More than 100 multipurpose reservoirs on the Missouri River and its tributaries with a capacity of 110,000,000 acre-feet of water for various uses.
2. Irrigation of more than 5,000,000 additional acres of land, and supplemental water for approximately 2,000,000 acres now receiving an inadequate supply.
3. Application of soil and moisture conservation measures on nearly 340,000,000 acres of farms, ranches, range lands, and forests to gain extensive benefits in erosion and sediment prevention, flood control, and improved agricultural production.
4. Hydroelectric plants having an ultimate installed generating capacity of 3,200,000 kilowatts and an annual output of more than 13,000,000,000 kilowatt-hours.
5. Control of floods by storage capacity exclusively for flood control in most of the reservoirs in the development program, providing for elimination or considerable reduction of flood damage on 5,000,000 acres of valley lands. Local flood-protection works at many cities, both large and small, shielding high-value areas subject to flooding.

Agricultural levees along the Missouri River from Sioux City, Iowa, to the mouth, protecting 1,400,000 acres of fertile farmland.

6. Stabilization works along the Missouri River to prevent erosion of valuable agricultural land, bridges and approaches, and industrial centers, and to establish a navigation channel up to Sioux City.
7. Controlled streamflow, through reservoir retentions and releases, to improve municipal, industrial, and domestic water supplies and alleviate stream pollution.
8. Improvement of fish and wildlife habitat and construction of new features to encourage such development.
9. Construction of recreational facilities at reservoir sites, in forests, and in other suitable areas to utilize recreational potentials.
10. Provision of statistical, informational and other aids to agriculture, industry and business, to promote the far-reaching gains and growth to be expected from full development of the Basin's resources.

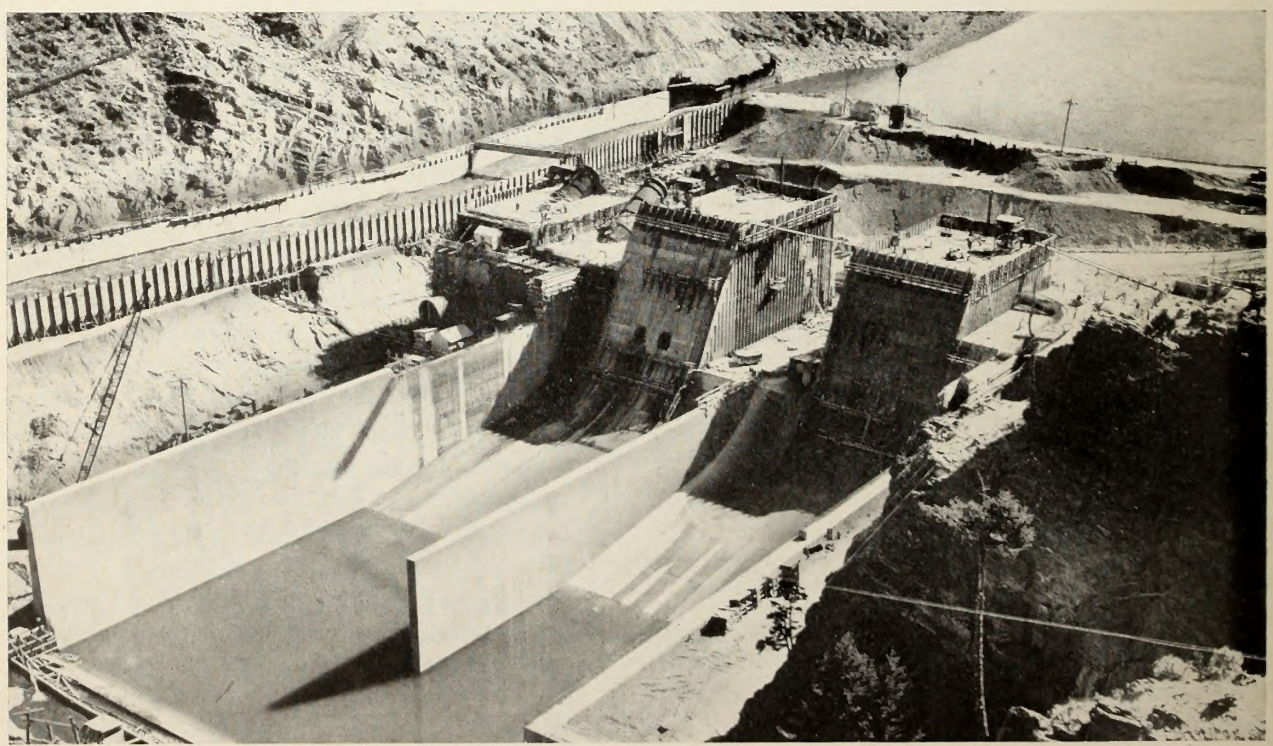
Several reservoirs and other features already have been completed, and much of the remaining program is well under way. The plan is a flexible one, subject to modification in the light of developing experience.

Because of the magnitude of this endeavor and the widespread nature of its benefits, reaching across state lines and even outside Basin boundaries, the major undertakings are being financed primarily by Federal funds. State and local agencies, however, play a key part by planning and correlating their own resources-development programs with the whole. The attainment of the program's goals involves individual participation by many thousands of Basin residents.

The broad concept of the plan was not developed at a single stroke but rather is a vast acceleration and coordination of the existing programs of many agencies, whose experience with the problems involved extends back for decades.

This booklet describes the Missouri River Basin Development Program—how it began, what it has done, and what is proposed for the future—and the organization which coordinates this program, the Missouri Basin Inter-Agency Committee.

Giant projects in the program are nearing completion. Shown here is the Canyon Ferry Dam in Montana. The flume at left carries the Missouri during construction.



THE MISSOURI RIVER BASIN

To understand and evaluate the plan, one must first know something of the Basin itself.

THE RIVER

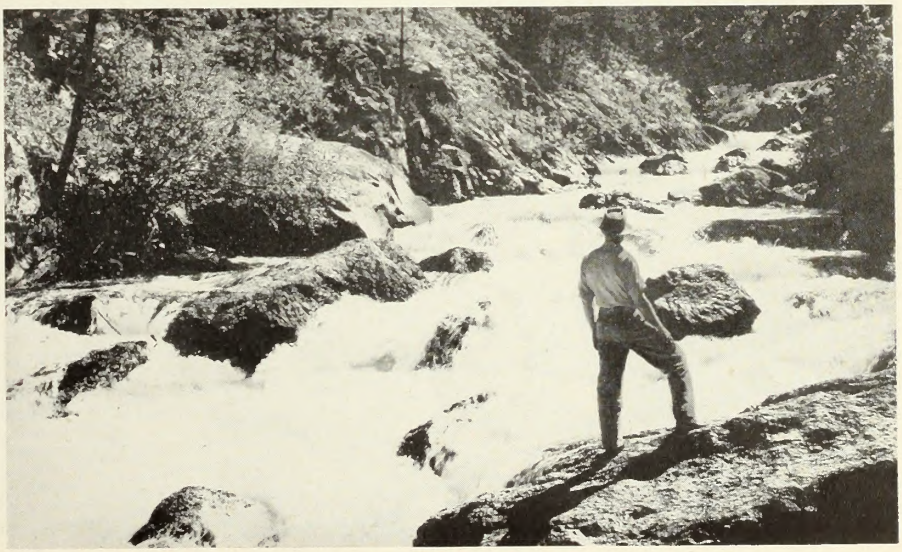
The 2,460-mile Missouri River starts its seaward journey near Three Forks, in southwestern Montana, where the Jefferson, Madison, and Gallatin Rivers join. Flowing north to Fort Benton, the Missouri turns east 400 miles to Garrison, N. Dak., then south and east to Sioux City, Iowa, and Kansas City, where it again turns east to cross the State of Missouri to its confluence with the Mississippi 17 miles above St. Louis.

In upper Montana, the Missouri occupies a narrow valley, but from there it moves into a wide foothills valley and later emerges on the plains to meander back and forth across a broad floodplain which averages five miles in width below Sioux City. The elevation of the river ranges from 4,000 feet above sea level at Three Forks to 400 feet at the mouth, and the slope from 5 feet per mile to only seven-tenths of a foot per mile.

It is a wild river, rising and falling swiftly, noted for the sudden and unexpected shifts in its channel, except where controlled.

During the period of record the discharge of the Missouri has ranged all the way from 2,500 to 441,000 cubic feet a second past Sioux City, and at Kansas City from 1, 500 to as high as 625,000 cubic feet a second. Fluctuation between the high and low water stages is 27.6 feet at Sioux City and 40.7 feet at Kansas City. Many tributaries, some with names that loom large in the history of the West, pour their waters into the Big Muddy. These include the Yellowstone, the Big Horn, the Cheyenne, the Platte, the Kansas, the Sioux, and the Osage.

Headwaters such as this mountain stream send the melting snows and rainfall run-off down the drainage slope to form the rivers of the Missouri Basin.



GEOGRAPHY

The Basin is 1,300 miles long and 700 miles wide, tapering more sharply at the lower, or Southeast, end.

It includes all or parts of the States of Nebraska, South Dakota, Montana, Wyoming, North Dakota, Missouri, Kansas, Iowa, Colorado, and Minnesota and a small part of Canada.

The Basin offers a wide diversity of geography and climate: The snowcapped peaks and the forests of the Rockies, the grassy prairies of the Dakotas, the waving wheat fields of Kansas, the corn belts of Iowa, and the hardwood-covered Ozark highlands of Missouri.

Temperatures as high as 121° and as low as minus 66° have been recorded. Average rainfall varies from 6 inches annually in parts of the Upper Basin to more than 40 inches in the lower part of the valley. Snow ranges from 20 inches in the Lower Basin to 200 inches a year in the mountains. The growing season may be all the way from 60 days in the Upper Basin to 190 days in the extreme southeast. The soils—red, black, chestnut, light brown, and gray—range from some of the world's most fertile farmland to barren, eroded badlands.

FARMS, INDUSTRY AND POPULATION

The Basin's economy is predominantly agricultural. Its farms and ranches produce one-third of the Nation's bread-grains, one-fifth of the beef, one-fourth of the pork, one-fifth of the butter, one-fourth of the mutton, and nearly one-third of the wool. The rural investment in land, buildings, livestock, and implements is about $15,000,000,000. In 1949 the Basin's farms and ranches yielded products worth approximately $4,000,000,000.

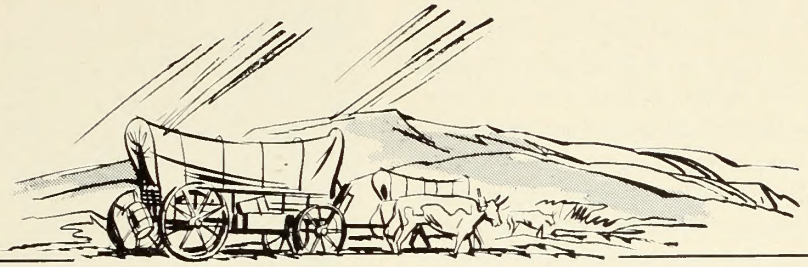
Manufacturing consists principally of processing crops and livestock into food products. In 1947, manufactured products in the nine Basin States other than Minnesota were valued at $3,510,782,000, or about 5 percent of the Nation's total. Minerals and mineral products in 1948 were worth $969,575,000, about 6.2 percent of the national output. In commerce, the Basin had in 1948 more than 6 percent of the $184,500,000,000 wholesale trade in the United States and nearly 6 percent of the $130,500,000,000 retail trade.

Fifty-five percent of the 8,000,000 population resides in the lower one-fourth of the Basin's area. While national census totals have risen 30 percent in 30 years, the Missouri Basin has shown only a slight gain. In the drought-depression-war decade following 1933, the Basin lost 750,000 farm residents, one-fourth of its farm population. Farm population now is a little less than 3,000,000.

Only four Basin cities are over 100,000 in population. Final census figures for 1950 showed: Kansas City, Mo., 456,300; Denver, Colo., 415,786; Omaha, Neb., 251,117; and Kansas City, Kans., 129,553.

Millions of dollars in damages follow in the wake of Missouri River floods. Kansas City's industrial district, completely inundated by the great flood of 1951.

THE BACKGROUND OF THE PROGRAM



The history of the Missouri River Basin Development Program is in a sense the history of the settlement of the West, of the pioneer farmers and their government, who, through good years and bad, through flood and drought, developed a system of agriculture dictated by the climatic adversities of the region.

The goal of the program—the conservation and beneficial use of the Basin's natural resources—has evolved from the early days of exploitation and waste through the grim realization that these resources were not inexhaustible.

EARLY HISTORY

In 1764 St. Louis was established as a fur depot, and for many years commerce on the Missouri, moving in canoes, pirogues, bullboats, mackinaws, and keelboats, was tied to the fur trade. In 1804, Lewis and Clark blazed a trail up the Missouri, across the Rockies, and on to the Pacific. Behind them came the trappers, traders, and prospectors. By 1819, there were steamboats on the river from St. Louis to Fort Benton, wood-burning side-wheelers which fought the snags, shoals, and shifting sands. The trip was hazardous, and many a steamer was lost. In 1824, money first was appropriated to the Corps of Engineers for a program of snag removal to aid navigation.

In the middle of the nineteenth century the westward march reached the Great Plains. Many crossed the plains bound for the Columbia Valley and California. Then the great mass migration halted for almost two decades.

After the passage of the Homestead Act of 1862, the men with the new steel plows and seed wheat from South Russia resumed the westward movement. Completion of the transcontinental railroads added new impetus, and by 1880 hordes of land-hungry settlers were rushing to the free land in the Basin.

EARLY DEVELOPMENTS

In 1881 Maj. Charles R. Sutter of the Corps of Engineers suggested to Congress the basic principles of river control still in use today, and in 1885 bank stabilization works which still are effective were built at Kansas City. The Corps of Engineers had begun its work to curb destruction by the river.

Early irrigation projects were relatively simple and inexpensive, but after the streams became fringed with fields, water storage became necessary. Soon cooperatives were formed and private capital was invested, but it became evident that the Federal Government would have to construct the more expensive projects.

The Reclamation Act of 1902 was an outgrowth of the needs of the West and the new impetus for conservation of the area's natural resources. It led shortly to creation of the Reclamation Service, now the Bureau of Reclamation of the Department of the Interior.

In the early decades of the twentieth century, conservationists warned against waste of the Nation's natural resources, and a great conservation movement began. New impetus was given the forest reserve and watershed-protection programs of the Department of Agriculture, and in the Department of the Interior there were added new natural-resource functions which in time were taken over by the Fish and Wildlife Service, the National Park Service, and the Bureau of Mines.

In the dust-bowl days of the thirties, black clouds of precious topsoil hovered over much of the Basin and many discouraged farmers abandoned their homes. In areas where irrigation was practiced the economy

remained on a comparatively even keel and some even gained population.

The Department of Agriculture, through its bureaus, experiment stations, and the land-grant colleges, had been helping farmers to develop crops and cropping methods that would withstand the climatic rigors of the Basin. New soil treatment practices and cover crops to hold topsoil in place were developed. Shelter belts were planted, and direct payments were made to farmers to help bear the cost of applying conservation measures.

By 1940, a total of 4,400,000 acres were under irrigation in the Missouri River Basin. Water was available and works had been constructed by the Bureau of Reclamation to supply 873,000 acres. Federally built hydroelectric power plants were supplementing private utilities in providing energy to farms, homes, and industry.

Many flood-control works had been constructed by local interests along the Missouri to protect the cities on the lower river and the rich farm land along the channel, but these did not provide adequate protection.

BASIN FLOODS

The floods of record which began with the great inundation of 1844 and continued through the disasters of 1881, 1903, 1909, 1915, 1927, 1935, 1942, 1943, 1944, 1947, 1951, and 1952, caused damages of many different types. There were losses of municipal, residential, and industrial properties and of agricultural products and livestock. There was fence and property damage, road and railroad damage and erosion and land damage. It has been estimated that on the major streams flood damages totaled $68,000,000 in 1943 and $213,000,000 in 1947. The floods of July 1951, in Kansas and Missouri, to then the most destructive in the history of the Basin, inflicted damages of more than $1,000,000,000. Since 1935 a total of 291 lives have been lost. Average annual flood damages on major streams have been estimated at more than $60,000,000, and on watersheds and small tributaries, the annual flood damages are $77,000,000. In addition, the annual land damage exclusive of sheet erosion has been estimated at $21,000,000, sediment damages at $17,500,000, and indirect losses at $32,500,000.

As the repetition of these flood disasters showed the futility of combating the menace with piecemeal measures, the Corps of Engineers in the early thirties began preparing reports envisioning complete, planned development of the Missouri River system for flood control and navigation.

In 1943 and 1944 the Corps of Engineers and the Bureau of Reclamation, working separately, completed investigations which resulted in the presentation to Congress of two plans for the development of the Basin's water resources.

The Corps of Engineers' plan had flood control as its principal objective. The Bureau of Reclamation's plan had irrigation as its principal objective. Both provided for power production and for conservation storage to regulate the flow of the Missouri River and its tributaries.

MISSOURI RIVER STATES COMMITTEE

In 1942, the governors of the nine principal Missouri Basin States organized a Missouri River States Committee, consisting of the governor and two other representatives from each State. This committee urged the integration of the two plans after they were presented.

FLOOD CONTROL ACT OF 1944

During extensive hearings before the Flood Control Committee of the House of Representatives, the two plans were revised and coordinated by the two agencies. This coordinated plan was approved by Congress in the Flood Control Act of 1944 and the initial stages authorized for construction. Subsequent legislation has expanded the authorization.

The act did not recite complete details, but rather it recognized the conservation and control of water as the key to resource development in the Missouri Basin.

Although the new plan was prepared from studies by the Corps of Engineers and the Bureau of Reclamation, it has required from its inception the continuing cooperation of many Federal and State agencies. Terrain and streams have had to be intensively measured and mapped for basic data. Power needs, stream pollution, and the myriad effects of the plan on agriculture, forests, fish and wildlife, business and industry, recreation, mineral resources, and the Indian population have had to be continuously considered and coordinated.

While the relationship between water resources and the Basin's watershed lands had been recognized since the first observed effects of cutting away the forests and plowing the virgin sod, plans for accelerated conservation and development of watershed lands had not yet been formulated.

Erosion can quickly ruin improperly managed farm land. Gullying such as this starts with rivulets of run-off water.

The Missouri River States Committee called attention to this deficiency shortly after construction started on the major river projects and recommended that land conservation be brought into balance.

BASIN AGRICULTURAL PLAN

The preparation of a Basin-wide agricultural program was promptly undertaken by the Department of Agriculture, with the assistance of the State agricultural colleges and other State agricultural and forestry agencies. Upon its completion early in 1949, the Missouri Basin Inter-Agency Committee recommended that Congress take steps to put it into effect. It was transmitted to Congress by the Secretary of Agriculture, and initial hearings were held in August 1950, but final action has not been taken to approve the program.

This program would become an integral part of coordinated Basin development. It would increase agricultural production and help carry the area through drought periods by reducing soil losses and by holding moisture in the soil for crop, forest, and range production. It would establish watershed practices and measures to reduce flood and sediment damages.

PROGRESS OF THE DEVELOPMENT

The Missouri River Basin Development Program is well under way, with many projects already in the construction and operation stages. Canyon Ferry, Garrison, Oahe, Fort Randall, and Gavins Point Dams and the navigation project, all on the Missouri, are in various stages of construction. The Kortes dam and power plant in Wyoming has been completed, and additional generating capacity is being installed at Fort Peck. Fourteen other reservoirs for flood control and irrigation have been completed or are nearing completion. Other projects such as the Colorado-Big Thompson project, while a separate authorization, are well along in construction. Colorado-Big T is now producing power at some of its plants. Considerable progress has been made on transmission line construction. Some of the reservoirs, together with levees and channel improvements recently completed, already have yielded flood control benefits.

However, some phases of the program are not yet authorized and many details of development still are in planning stages. Policy and details of the program are constantly evolving with changing needs and with increased experience and knowledge. A final blueprint for this gigantic undertaking should not be drawn, nor need it be drawn in all details before initial steps are taken.

PARTICIPATING AGENCIES

Directly participating in the program are the 10 Missouri Basin State governments and related local government units; the Federal Government, through 6 of its major departments or agencies, and the farmers and ranchers who own and operate the land and water rights. Directly or indirectly, all the people in the Basin are participants.

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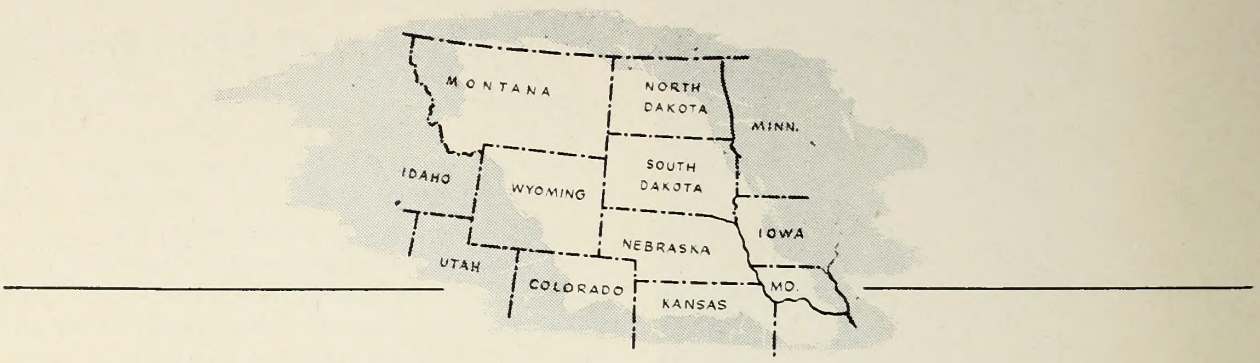
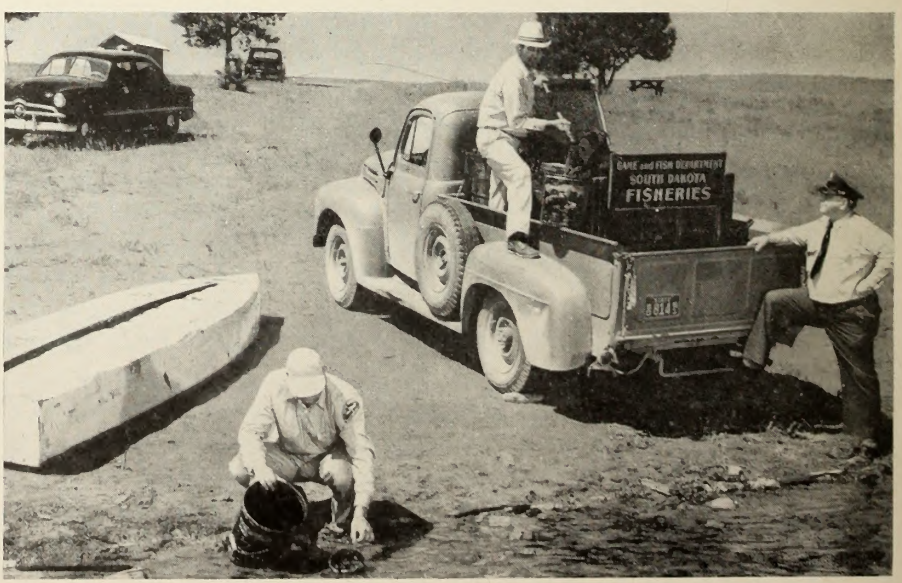
THE STATE PROGRAMS



For many years all the Missouri Basin States have had continuing programs to develop and conserve the land and water resources within their respective boundaries, often in cooperation with the Federal Government. Incorporating these programs into the Missouri River Basin Development Program has caused them to be speeded up or altered to match accelerated Federal activity.

Special appropriations have been made by some State legislatures to enable State agencies to coordinate with the over-all Basin program. Although the State programs differ in scope and emphasis, all of them have agricultural programs, consisting principally of research work at experiment stations or demonstration farms and extension work carried on through the land grant colleges. Soil conservation work is provided for in all States. All of the Basin States have agencies handling game and fish, and nearly all have agencies responsible for forestry, parks, and recreation; all of them have programs for public health and geological investigations, which usually include minerals, water resources, and topographic mapping. All the States have agencies for the promotion of industrial development.

Where irrigation is extensive, there are agencies to administer the water laws, protect and conserve water resources or, in some cases, engage in irrigation construction. Several States make special studies of flood control and irrigation.



State game and fish departments play an important part in the Basin development program. Here a reservoir is being stocked with trout.

THE MISSOURI BASIN INTER-AGENCY COMMITTEE

Under the broad program of resources development there was immediate need to view the undertaking as a whole and to coordinate all the related activities.

To meet this need, the Missouri Basin Inter-Agency Committee was established in April 1945 by the Federal Inter-Agency River Basin Committee in Washington, whose members since 1943 have worked towards coordinating river-basin-resource development at the national level.

The Inter-Agency Committee is not set up by law and exercises no administrative controls. It relies for its effectiveness on the determination of its member agencies, both Federal and State, to work on a voluntary basis toward a common goal.

MEMBERS

The Federal members are representative of the Department of the Interior, Corps of Engineers, Department of Agriculture, and the Federal Power Commission, with the Department of Commerce added in 1947 and the Public Health Service in 1951.

The 10 Basin States were represented on the committee until 1947 by 4 governors chosen by the Missouri River States Committee and by 5 governors until January 1952, at which time all 10 governors were made official representatives of the States. The chairman has been chosen from among the Federal members. All members, both State and Federal, participate equally on the committee.

The Inter-Agency Committee held its first meeting July 19, 1945, in Omaha, and in the first 6 years of its existence has met 50 times in the various Basin State capitals and other cities convenient to project sites.

CHAIRMEN

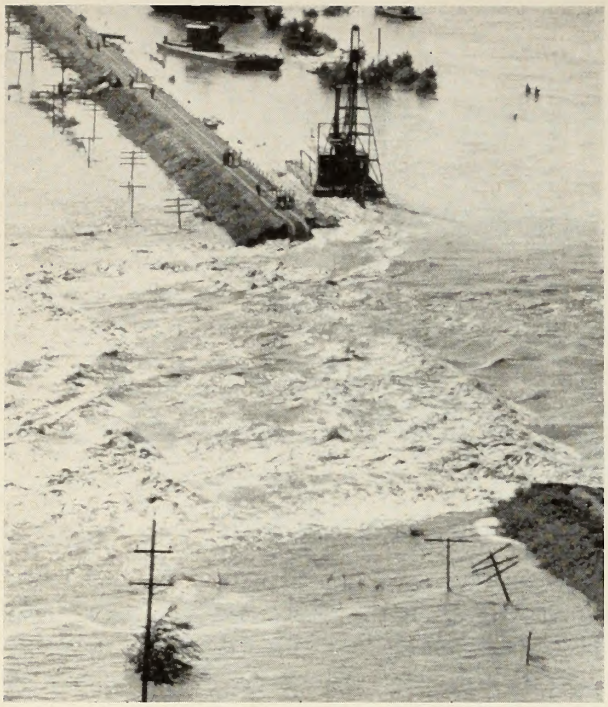
The first chairman, Brig. Gen. R. C. Crawford of the Corps of Engineers, served until November 1945. He was succeeded by Maj. Gen. Lewis A. Pick, who held the post more than 3 years before going to Washington in March 1949 as Chief of Engineers. W. G. Sloan, chairman of the Interior Missouri Basin Field Committee, succeeded General Pick, and in June 1950 Mr. Sloan was succeeded by Gladwin E. Young, chairman of the Missouri Basin Field Committee of the Department of Agriculture. B. H. Greene, regional engineer for the Federal Power Commission, succeeded Young in June of 1951.

Attendance at the meetings to date has averaged 98 percent by the Federal members, and 62 percent by the governors despite the pressure of their State duties and the lengthy trips involved.

PROJECT TOURS

Tours of various projects have been held in connection with 21 of the 50 meetings, enabling those on the committee to gain first-hand knowledge of the work in progress. A custom also has arisen of holding a civic meeting in the evening in connection with committee sessions, with an Inter-Agency spokesman explaining the program.

Increasing attention to the work of the committee has been evidenced by attendance at the sessions, which are always open to the public. From an average of 44 persons in 1945, it rose to 83 during 1949, and in 1950 averaged 130. Minutes of the meetings are distributed to interested individuals, agencies, and educational institutions.



Floods ravage urban and rural areas alike. This 1947 levee break at Glasgow, Mo., shows the violence of the Big Muddy on a rampage.

From the very first meeting, there has been a studied effort by the committee to inform thoroughly not only the members but also the press and public of the many details of the program, the progress being made, and the problems of coordination continually arising.

POLICIES AND COORDINATION

Preliminary planning, operating procedures, and policies are reviewed and subjected to the test of Basin-wide objectives. Increasingly in the committee's work there has been evident among the members a shift from the specialist's viewpoint to a broader, Basin-wide concept of the program.

Committee meetings frequently take on the aspects of a forum involving points of view on policy and objectives, as well as on technical details. Thus, many divergent views have been brought together and resolved. There has been a great increase in joint studies and investigations by Federal and State agencies. The facts so gained are reported at the meetings so that all may participate in interpretations.

An outstanding example of such a joint study is a recent report entitled, "Adequacy of Flows in the Missouri River," which brings together the best information available on adequacy of water for the various uses.

SIX-YEAR PROGRAM

Another effective procedure used to guide the timing of related work has been the compilation of a series of reports known as *The Six-Year Program.* The first of these reports was issued in January 1948 after several months' work by a subcommittee.

The Six-Year Program reports have listed individual projects, expenditures made to date, expenditures required over a succeeding 6-year period, and the total funds required to complete the work. With appropriate tables, this information has been summarized into Basin and State totals.

This listing of related work required to carry out a Basin-wide program crystallized for the first time an awareness of the interrelated problems involved. Problems of timing of plans and of construction phases now stand out more clearly.

Publication of *The Six-Year Program* reports has entailed projections of estimates into an uncertain future. Rates of progress anticipated for the immediate years ahead now will be changed by requirements of the Nation's defense. This does not invalidate the ultimate objectives of the Basin program, but it will require constant rescheduling.

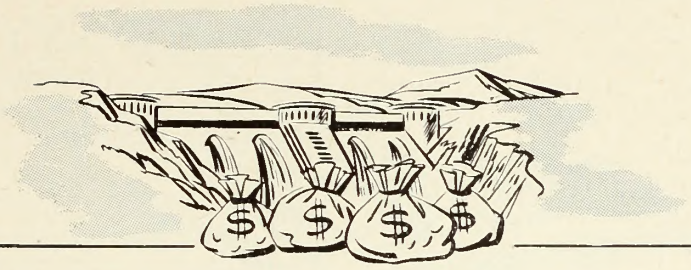
The first steps and the final authority for coordination of the Basin program rest with Congress and the State legislatures. Administrative coordination can proceed only within the limits of authority established by law and the appropriations that permit each phase to proceed in proper sequence.

OTHER COORDINATING GROUPS

Coordination of efforts within this framework has found expression not only in the Inter-Agency Committee but within each agency. The Department of the Interior and the Department of Agriculture maintain active committees to coordinate the work of their many bureaus.

One of the most outstanding and influential coordinating efforts has been that of the Missouri River States Committee, to which goes much of the credit for promoting the coordinated planning and legislation authorizing the first steps of the program.

COSTS OF THE PLAN



Costs for the program as now conceived are estimated at $9,400,000,000, which includes Federal and State expenditures. These estimates are shown in detail in *The 1951 Program for Land and Water Resources Development of the Missouri River Basin*, the most recent summary of the Inter-Agency Committee's 6-year program.

These estimates and scheduled completions are subject to revision as a result of the present defense program and the rising trend of construction costs.

REIMBURSABLE BENEFITS

Costs for irrigation, power, and municipal water supply are, in large measure, reimbursable under existing law. Repayment of this Federal investment by the beneficiaries will commence long before the entire program is completed.

Most other benefits of the program are, by law, nonreimbursable. Among these are benefits from flood control, navigation, improved land practices, pollution abatement, and enhancement of recreational opportunities. In the aggregate, annual benefits will exceed annual costs by a substantial amount.

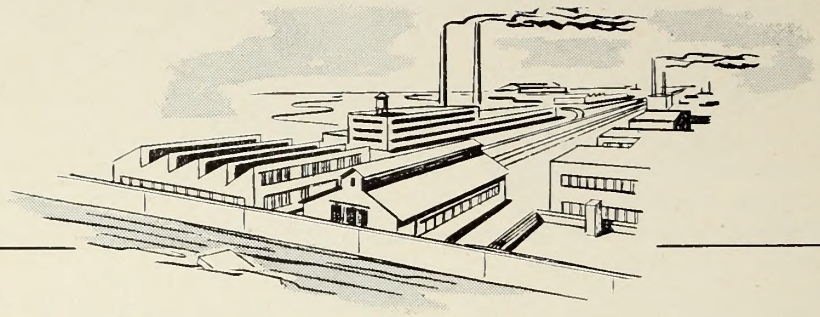
RELATED BENEFITS

Of great magnitude, though not susceptible to monetary determination, are the expected indirect and secondary benefits in the growth of industry, business, and population. Many of these will be felt not only within the Basin, but throughout the Nation. The accelerated resources-development program will contribute to widespread expansion in the processing and use of the products of Basin farms, forests, and mines.

The increased purchasing power of Basin residents will expand the markets for many products from other parts of the country.

Drought has been the scourge of Missouri Basin farmers when endless days without rain left desolate scenes such as this, on an abandoned South Dakota farm in the Dust Bowl thirties.

FLOOD CONTROL



The Missouri River Basin Development Program proposes a three-way attack on the problem of flood control: Retardation of runoff water through improved land practices and upland structures; storage of floodwaters in reservoirs, and protection of both cities and farm land by means of levees.

The basic structural feature of the development is the large multipurpose reservoir, storing runoff waters on both the main stem of the Missouri and its tributaries. These dams not only hold back destructive floodwaters but hold those same waters available to reclaim arid cropland, generate electricity for existing and new industry, and provide regulated flow downstream for dependable water supply, pollution abatement, and navigation. Further, the creation of these large bodies of water in the land-bound Midwest offers a glowing vista of new recreation in the form of fishing, hunting, boating, swimming, camping, and picnicking.

Three distinct storage zones are contained in a multipurpose reservoir. The upper zone, normally kept empty, is allowance for floodwater storage. The bottom zone is inactive storage, providing the minimum pool for fish propagation, hydroelectric-power head and siltation allowance. Between these two zones lies the flexible storage, storing excess water for irrigation releases, power generation, and downstream needs.

MAIN-STEM DAMS

The largest reservoirs in the program are the four structures on the main stem of the Missouri: Fort Peck, Garrison, Oahe, and Fort Randall. Together they will have a storage capacity of more than 70,000,000 acre-feet of the projected 110,000,000 acre-feet in the plan.[1]

These giant mounds of selected, compacted earth, together with the smaller Big Bend and Gavins Point Dams, will form a series of reservoirs along the Big Muddy from Montana through the Dakotas like terraced steps of water down the valley. The flow of the Missouri will thus be harnessed to produce annually 6,800,000,000 kilowatt-hours of electrical energy.

The prototype of these dams in the Basin was Fort Peck on the Missouri in northeastern Montana. Construction of this dam was started in 1933, originally for the benefit of navigation, and it was placed in operation in 1938.

In the first 11 years' operation, Fort Peck was estimated to have averted $51,000,000 in flood damage, reducing flood crests by as much as 3 feet at Omaha. Although transmission facilities are not complete, electric power generated since 1943 yielded gross revenue of $4,969,992 to June 30, 1950. The installation was increased from 50,000 to 85,000 kilowatts in December 1951.

More recently the fish and wildlife resources at the reservoir have increased in importance, with substantial catches of 24 different species of fish.

By September 1951, Garrison was 40 percent completed and Fort Randall approximately 50 percent completed. Oahe was well started, and Gavins Point in the planning stage.

[1] See Appendix A for data on reservoirs in the plan.

TRIBUTARY PROJECTS

On tributaries of the Missouri, two Corps of Engineers dams had been completed and two others were under construction. The Kanopolis Reservoir on the Smoky Hill River near Salina, Kans., was completed in the spring of 1948 and the Cherry Creek Dam to protect the city of Denver was finished in the summer of 1950. The Harlan County Reservoir on the Republiean River near Alma, Nebr., was nearly completed and construction had been started on the Coldbrook Dam upstream from Hot Springs, S. Dak.

Awaiting construction were the Tuttle Creek Dam on the Blue River north of Manhattan, Kans., Chatfield Dam on the South Platte River southwest of Denver, Red Willow Dam on Red Willow Creek north of McCook, Nebr., Pioneer Reservoir on the Arikaree River in the extreme northwest corner of Kansas, and Pomme de Terre Reservoir on the river of that name upstream from Hermitage, Mo. Five additional reservoirs have been authorized but are in an inaetive status pending authorization of alternate plans.

The Corps of Engineers also determines the flood-control storage capacity for reservoirs which are primarily for irrigation and preseribes operating regulations for sueh storage. During a major flood, the Corps of Engineers coordinates the operation of flood-control storage in all Basin reservoirs.

RESERVOIR OUTLEASES

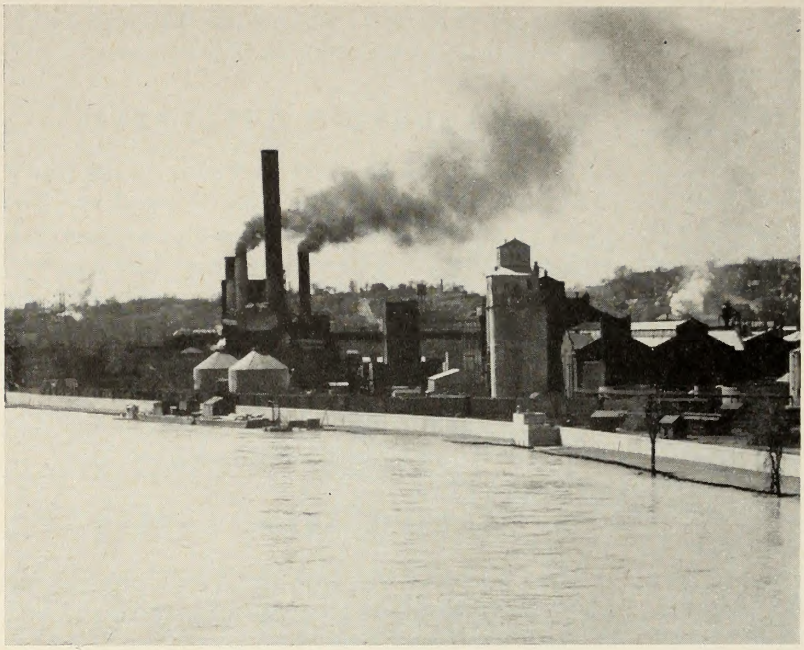
In building flood-control reservoirs, all the land in the flood pool inundation area is acquired. That part of the area above the conservation pool, land which might be under water very infrequently, is leased for agricultural use. The law requires that 75 percent of the lease revenues go to the county school and road funds in the affected area, in lieu of lost tax revenues. In reservoirs so far completed, these lease returns have exceeded what the taxes would have been from the entire reservoir area.

AGRICULTURAL LEVEES

The Missouri River agricultural levee program calls for the construction of 1,500 miles of levees, comprising 144 units, on the main stem below Sioux City in Iowa, Nebraska, Kansas, and Missouri. These units will proteet almost 1,500,000 acres. Construetion started in June 1948 and by 1951 seven units had been essentially completed and seven others were under construetion. Damages which would result from an uncontrolled flood of the height for which the levee projeet is designed are estimated at $150,000,000. Completion of the projeet is seheduled for 1962.

In contrast to the private levees, which are of various height and quality, the new Federal units are of uniform construction. Built of semi-compacted earth fill, they have a 10-foot width on top, slopes of 1-on-3, and heights designed to provide 2 feet of elearanee above the design flood. Average height is from 12 to 14 feet. Structures providing internal drainage are included where needed, and measures are

Immensity of the Fort Randall project is shown in this panoramic air view. The structures in the foreground are the intakes of the twelve tunnels.



Results of the flood-wall program are plainly seen in this picture of high water being contained at Omaha in April 1950.

taken to insure stability of the levees, such as construction of berms or seepage wells on the landward side where foundation conditions require.

The Agricultural program proposes a coordinated effort for drainage of the lands behind the levees through technical assistance and direct financial aids to drainage districts and other groups.

LOCAL PROTECTION PROJECTS

To safeguard the rich industrial and commercial concentrations as well as the residents of Missouri Basin cities, local flood protection in the form of earthen levees and concrete floodwalls is provided at numerous locations, supplementing the protection provided by upstream reservoirs.

Under the Flood Control Act of 1936, local interests must supply rights-of-way and easements for such works, hold the United States free of construction damages, and maintain the levees and floodwalls after completion.

The largest of these projects is at the Kansas Citys, where the junction of the Missouri and Kansas Rivers creates a particular flood hazard to industrial development valued at more than $1,000,000,000. The authorized project was reported as 59 percent completed as of September 1951.

At Omaha, the 12.5-mile levee and floodwall barrier was virtually completed by 1950.

At Council Bluffs, Iowa, across the river, an 8.7-mile system has been completed. In 1950 the two systems averted flood loss of $2,000,000, and in 1952 catastrophes were prevented which have not yet been evaluated.

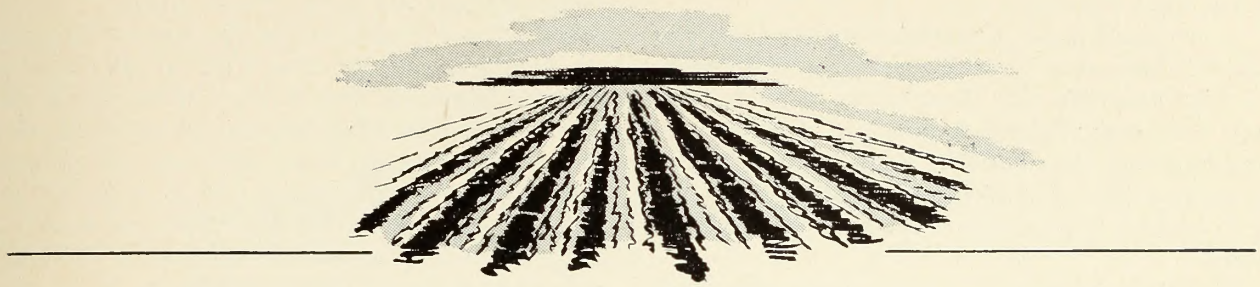
Local protection at 31 other flood-threatened towns presently is incorporated in the Basin plan. Nine of these projects have been completed at South Topeka, Kans.; Hamburg, Iowa; Indianola, Nebr.; Belle Fourche, S. Dak.; Glasgow and Forsyth, Mont.; Bartley, Nebr.; Mandan, N. Dak.; and Hot Springs, S. Dak.

Two other Basin flood-control projects involve principally channel alteration, on the Chariton River in Missouri and the Little Sioux River in Western Iowa. River-bank stabilization is the objective of two projects on the Missouri River from Sioux City to Kensler's and Miner's Bends, Nebraska and South Dakota, and on the Platte River at Schuyler, Nebraska.

NEW AUTHORIZATIONS

Additional project investigations for flood control are undertaken on direction of Congress. After determining the extent of the flood problem and the desires of local interests, a preliminary report is made to show whether detailed studies are warranted. When additional study is warranted, a further report is prepared with appropriate coordination with local, State and interested Federal agencies. Public hearings then are held and comments are obtained from the affected States and Federal agencies involved. Only improvement plans which offer engineering soundness, economic feasibility, and acceptability to local interests are recommended to Congress. If authorized in a flood-control act, the improvements then become eligible for Federal assistance.

IRRIGATION



The importance of irrigation to a great segment of the United States often is not realized by residents in areas of ample rainfall. Over a large part of the West the income from irrigated crops and from livestock fed with the aid of irrigated crops contributes much to the stabilization of agriculture.

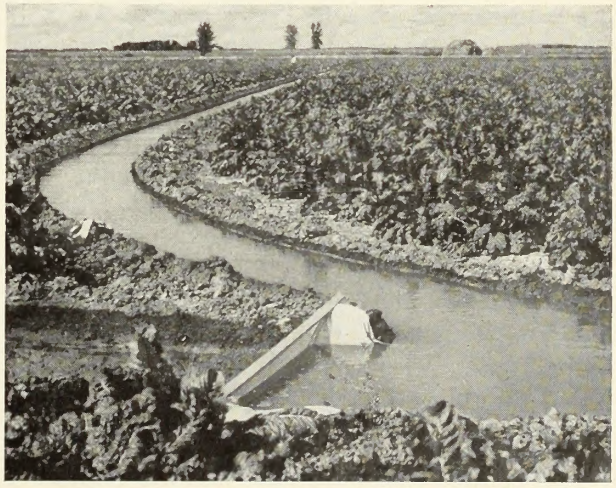
By 1940, a total of 4,400,000 acres were under irrigation in the Missouri River Basin. Water was available and works had been constructed by the Bureau of Reclamation to supply 873,000 acres. Some of the first projects built by the Bureau of Reclamation following passage of the 1902 act are in the Basin.

MULTI-PURPOSE PLANNING

Over the years the reclamation program has grown from single-purpose projects to multiple-purpose, Basin-wide developments such as the Missouri River Basin project. The plan presented to Congress in 1944 was a multiple-purpose water-resource development including irrigation, navigation, power production, flood control, municipal and domestic water supply, alleviation of pollution, recreation, and improvement of fish and wildlife habitat.

Originally the program proposed the irrigation of 4,760,000 acres of new land and supplemental water for about 547,000 acres inadequately irrigated in the Basin. Since then, there have been several changes in plans, but the development pattern remains unchanged. Modifications have resulted from more detailed studies which are part of the continuing program, seeking the most beneficial use of Basin water resources. As now planned, the program will supply about 5,356,000 new acres and provide supplemental water for about 2,000,000 acres.

During the drought of the 1930's, the people of the Basin observed with renewed interest that irrigated agriculture provided dual stabilization, of human livelihood as well as crop production. No reclamation area lost population during the drought period; in fact, all areas gained population. On the North Platte project in Nebraska, from 1930 to 1940, Scotts Bluff County gained 18 percent in population and the city of Scottsbluff gained 42 percent, although the total population of Nebraska declined almost 5 percent.



Irrigation will bring new farm wealth under the Basin program. This rich field of sugar beets is on the Lower Yellowstone project, an early Basin development.

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In 1935, the worst drought year, irrigated crops on the Lower Yellowstone project in North Dakota averaged $35 an acre while adjacent dry-farmed crops averaged only 70 cents an acre. Reclamation paid big dividends during those years and was not forgotten when plans were made for greater beneficial use of Basin water resources.

In carrying forward its portion of the Missouri River Basin Development Program, the Bureau of Reclamation has a fourfold task: To construct, develop, operate, and maintain initial units; to proceed with investigations and studies for future construction; to develop additional needed units; and to collect the reimbursable Federal costs of water-resource developments.

With the appropriation of initial construction funds in 1945, the work was scheduled so that key units would be completed in a sequence to best meet Basin needs.

CONSTRUCTION PROGRESS

By September, 1951, nine multipurpose structures and three major diversion dams were completed, as well as many miles of distribution canals.[1] These included Dickinson and Heart Butte Dams on the Heart River in North Dakota, Shadehill Dam on the Grand River and Angostura Dam on the Cheyenne River in South Dakota, Medicine Creek and Enders Dam on the Frenchman-Cambridge Division in Nebraska, Kortes Dam on the North Platte River in Wyoming, Bonny Dam on the South Fork of the Republican River in Colorado, and Cedar Bluff Dam on the Smoky Hill River in Kansas. Under construction were Canyon Ferry Dam on the Missouri River in Montana, Boysen Dam on the Bighorn River, and Keyhole Dam on the Belle Fourche River in Wyoming, and Trenton Dam on the Republican River in Nebraska.

These structures ultimately will make possible the irrigation of more than 910,000 acres in the Basin. Power plants, integral parts of these multipurpose structures, will produce annually about 514,000,000 kilowatt-hours of electric energy under normal water conditions.

The Colorado-Big Thompson project, though not a part of the Bureau of Reclamation's Missouri River Basin project, will deliver supplemental irrigation water to 615,000 acres of land in northeastern Colorado, within the Basin. The project involves the diversion of Colorado River water through a tunnel from the Western Slope of the Rocky Mountains to the Eastern Slope. It consists of five dams, three natural lakes, six power plants with a total capacity of 177,650 kilowatts, the Alva B. Adams Tunnel about 13 miles long through the Continental Divide, two pumping plants and many miles of canals.

The water is impounded on the Western Slope in the Granby Reservoir, then lifted by the Granby pumping plant 186 feet to the Granby Canal. It flows into Shadow Mountain and Grand Lakes, two connected bodies of water, and into the Adams Tunnel. Also on the Western Slope is the Green Mountain Reservoir on the Blue River near Kremmling, Colo., to firm up downstream flows on the Colorado River below the Granby Reservoir.

Dropping 2,000 feet from the east tunnel portal, the water will furnish a power head for five power plants on the Eastern Slope. Regulatory storage is provided by the Olympus Dam and the Carter Lake and Flatiron Reservoirs before the water proceeds through the 14.6 mile Horsetooth Feeder Canal into the Horsetooth Reservoir. From there the water passes north into the distribution system, through the Poudre Supply Canal, as other water goes south from Carter Lake into the St. Vrain Supply Canal.

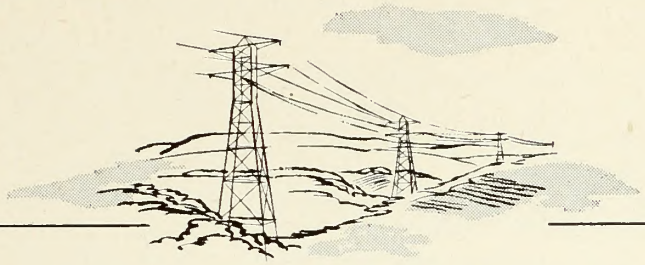
BLUE-SOUTH PLATTE PROJECT

Not yet authorized but under investigation is an even larger transmountain diversion to serve central Colorado, the Blue-South Platte project, involving 83,000 acres of new irrigation, 264,000 acres of supplemental irrigation, and 266,000 kilowatts of hydroelectric generating capacity.

Increased agricultural production as a result of the Basin development program is illustrated by this broad field of beans on the Shoshone project in Wyoming.

[1] See Appendix A for reservoir data.

ELECTRIC POWER



When the Federal Government began to build navigation dams in the East and irrigation storage reservoirs in the West, it soon became evident that the heads so developed could be used to generate power for construction operations, irrigation pumping, and other purposes. Energy produced by early projects exceeded project needs and became available for nearby communities. Thus arose the concept of a multiple-purpose reservoir. Power from such projects has made a great contribution to the development of the vast and sparsely settled parts of the Nation.

PROPOSED POWER INSTALLATIONS

The Missouri River Basin Development Program as now planned contemplates a total installation of approximately 3,200,000 kilowatts of hydroelectric generating capacity, producing annually about 13,000,000,000 kilowatt-hours of energy. As of September 1951, 38 plants with an installed capacity of 2,500,000 kilowatts were authorized. Of these, plants constructed by the Corps of Engineers will furnish about 1,500,000 kilowatts and Bureau of Reclamation plants more than 1,000,000 kilowatts. The entire output will be marketed by the Bureau.

In the past, power loads in much of the Basin have been small and widely scattered, because of the lack of large population centers and extensive industrial areas. The resulting smaller, scattered plants, with the extensive transmission system required, have resulted in higher costs of serving the consumer.

Generating capacity in the Basin in 1946 was 3,516,000 kilowatts, of which 943,000 kilowatts was publicly owned. Of this total, hydroelectric capacity accounted for about 882,000 kilowatts. The public power state of Nebraska had in 1946 nearly 410,000 kilowatts installed capacity, of which nearly 140,000 kilowatts was hydroelectric.

INCREASED DEMAND

The demand for power in the Basin, as throughout the Nation, has risen rapidly in recent years. Residential use averaged about 900 kilowatt-hours per customer annually in 1940, approximately 1,600 kilowatt-hours in 1950, and by 1970 has been estimated by the Federal Power Commission to vary throughout the Basin from 3,500 to 5,000 kilowatt-hours.

During the past 15 years the percentage of farms electrified in the Basin has risen from less than 8 percent to more than 80 percent. In the middle thirties, farm consumption averaged about 1,000 kilowatt-hours annually; the present average is about 2,400 kilowatt-hours and is expected to be between 4,200 and 6,000 kilowatt-hours by 1970, making up about 10 percent of total Basin requirements.

In recent years the Rural Electrification Administration of the Department of Agriculture has found a large energy demand from pump irrigation, particularly in the western part of the Basin. It is estimated there are more than 8,000 irrigation wells in Nebraska, with many others in northeastern Colorado, Montana, Wyoming, and western Kansas. A few experimental wells are located in North and South Dakota. The Nebraska wells alone require approximately 150,000 horsepower, which is being met with tractors, station-

ary engines using butane and Diesel fuel, and electricity. Power requirements will be increased by greater use of pipe and sprinkler delivery to the land.

Future pump-irrigation demands will be determined by the availability of three-phase service at well locations, cost of electricity, and ground-water supply. This demand could reach 500,000 kilowatts, with energy requirements of 1,000,000,000 kilowatt-hours annually by 1970. Such a delivery would be a major problem for electric cooperatives and utilities serving rural areas.

BASIN POWER NEEDS

The Basin has been below the national level in power use because of its low population density, the high proportion of farm population and the low degree of industrialization. The great dependency on agriculture, together with unstable farm prices and some extended periods of insufficient rainfall, limited the economy of much of the region prior to 1940. These factors, together with high generation and transmission costs in supplying wide areas from small, scattered plants, have retarded power development.

Stabilized farm incomes, increased production through irrigation, reduction of flood damages and decreased transportation cost through navigation, together with the stimulating effect of the hydroelectric developments, will improve the economy of the area. Expanded agriculture, commerce, and industry will support a growing population and accelerate Basin power demand.

TRANSMISSION SYSTEM

The present plan calls for the plants to be interconnected by a transmission grid into an integrated system. Although the minimum combination of head and flow at any water power plant determines firm capacity, interconnection of several plants whose minimum capacities do not occur simultaneously gives a system capacity greater than the combined minima. The largest plants in the plan are at the big, multipurpose dams on the Missouri's main stem.

The Federal transmission system in the Basin, consisting principally of 230-kilovolt and 115-kilovolt lines, was well under way by 1951. Construction is being correlated with the program of REA-financed cooperatives and with existing private and public power-district systems to provide wide distribution at reasonable cost.

EARLY FEDERAL PLANTS IN THE BASIN

Six Federal hydroelectric plants were in operation in the Basin in 1944. They were Fort Peck, with an installation of 35,000 kilowatts at that time, and five Bureau plants: Seminoe on the Kendrick unit (32,400 kilowatts); Pilot Butte on the Riverton project (1,600 kilowatts); Shoshone on the Shoshone project (5,600 kilowatts); and Guernsey (4,800 kilowatts) and Lingle (1,400 kilowatts) on the North Platte unit. Since then, 50,000 kilowatts have been added at Fort Peck, 36,000 kilowatts at Kortes and 5,000 kilowatts at Heart Mountain (Shoshone project). These plants and the Colorado-Big Thompson plants in fiscal year 1950 generated over 760,000,000 kilowatt-hours.

The Kortes plant on the North Platte River in Wyoming is the first hydroelectric plant of the Missouri River Basin Project to produce electric power. The third and final unit of the plant was placed in operation in January 1951. The plant's 36,000 kilowatts of generating capacity were immediately absorbed by the power-hungry market area.

Initial firm power from the first of the large dams, Garrison and Randall, when supplemented by approximately one-third the capacity of Fort Peck, is expected to be about 100,000 kilowatts in 1954; 400,000 kilowatts in 1955, and 570,000 kilowatts in 1956. It will be marketed in North and South Dakota and other areas within economical and feasible transmission distances.

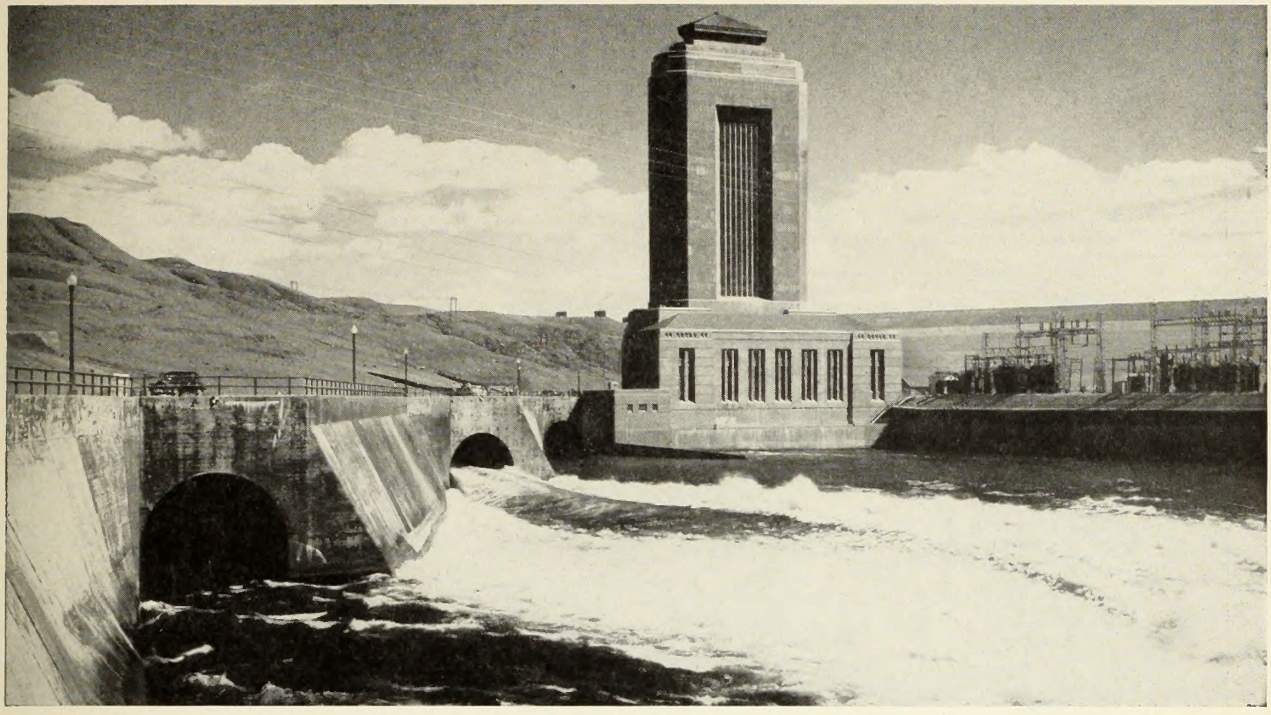
Draft contracts have been sent to many customers in this area. In addition, contract negotiations have been completed with several REA-financed cooperatives and six private utilities for use of their transmission lines.

POWER AGENCIES

The Bureau of Reclamation and the Corps of Engineers have primary responsibility for the planning, design, and construction of dams and power plants. The Federal Power Commission acts as a consultant on plans for power development and on potential power requirements.

The Commission also licenses hydroelectric power developments by non-Federal interests. The Rural Electrification Administration has integrated its loans with the programs of these agencies to meet Basin generating and transmission problems.

The FPC in five area reports has estimated Basin power requirements and supply from 1950 to 1970. Loads expected to be served by industrial facilities are



Hydroelectric power generated at the big dams will serve homes and both new and existing industry in the Basin. This is the Fort Peck, Montana, powerhouse.

not included. The bulk of the load is in the more populous Lower Basin.

REQUIREMENT AND DEMAND ESTIMATES

Total power requirements, including reserve allowance, are estimated to be:

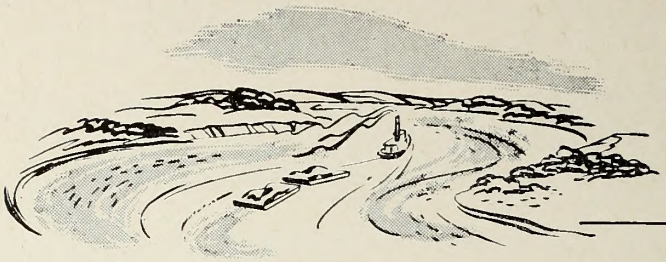
1950—4,258,000 kilowatts
1960—6,611,000 kilowatts
1970—9,442,000 kilowatts

The 1950 supply was estimated at 4,136,000 kilowatts, indicating an encroachment on reserve requirements of 122,000 kilowatts. The first of the new Basin units were placed on the line in 1950, however, and by the end of 1955 these plants are expected to add another 500,000 kilowatts. Load growth after 1955 will rapidly absorb this new capacity so that by 1970 it will have been necessary to provide considerable additional capacity to that of the Basin program.

Allowing for retirement, plants operating in 1950 will have a capacity in 1970 of 2,717,000 kilowatts. Thus, to meet 1970 requirements of 9,442,000 kilowatts will require a further 6,725,000 kilowatts. A substantial part of this new capacity will be needed in the lower Basin States. The authorized plants listed in Appendix C will all be located in the upstream part of the Basin and can supply a large part of the load growth in that area. For the downstream section new power demands will have to be supplied largely by additional fuel-electric capacity on existing public and private systems, although a part may be supplied by additional hydroclectric plants at sites not yet fully investigated.

Preliminary studies by various agencies indicate that there are a number of potential hydroelectric developments beyond those now included in the authorized program. Among these is the possibility of developing the head on the Missouri River between Yankton and the mouth—a possibility that needs exhaustive study to determine its feasibility. This study would include the potential for power resulting from the development of slack-water navigation. Also, a recent report by the Bureau of Reclamation includes reconnaissance-type data on additional hydroelectric and fuel-electric potentialities in the Basin. Further investigations are required before these additional potential developments are included in the program.

NAVIGATION



The Missouri River Basin Development Program calls for a 9-foot navigation channel, 300 feet wide, from the mouth of the Missouri River to Sioux City, a distance of 762.5 miles. Further extension upstream is under study.

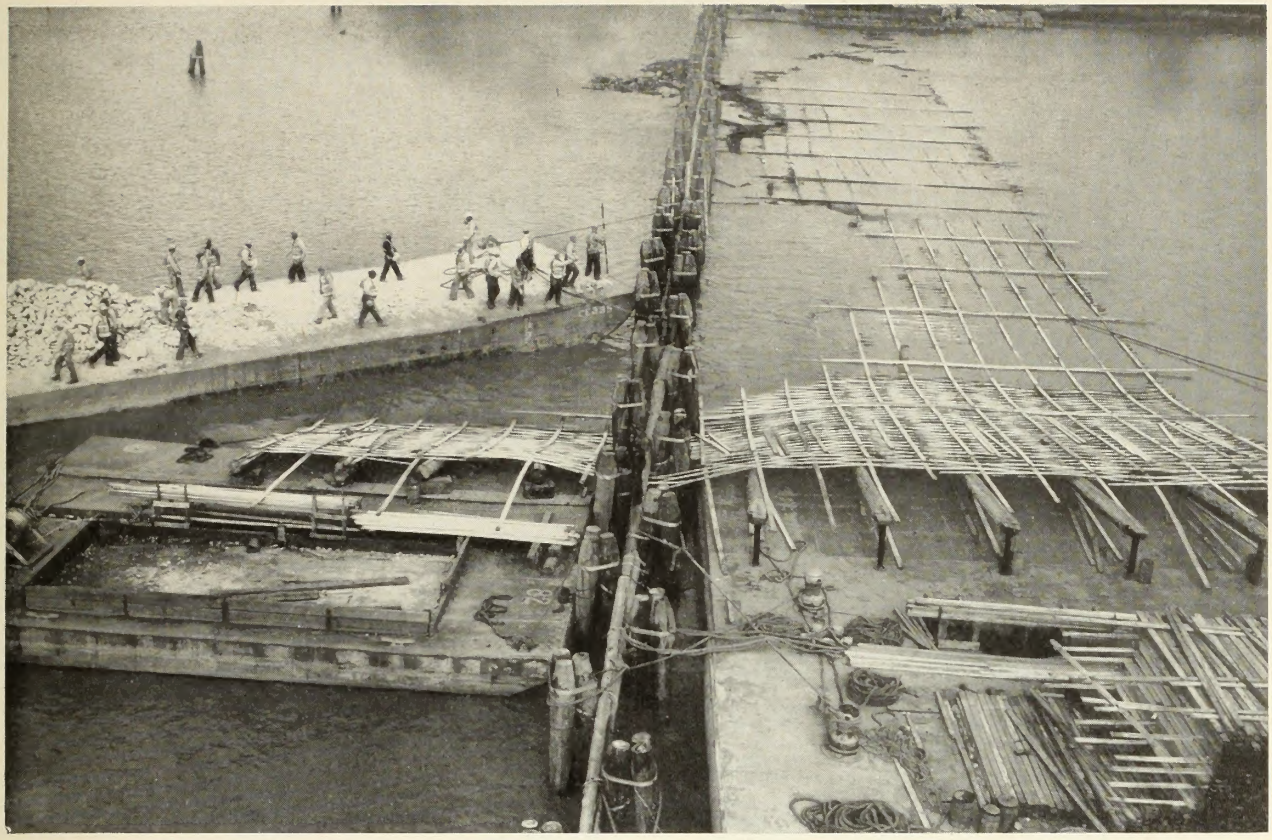
Early navigation on the river was hazardous because the natural stream was wide and shallow, with many islands. It meandered back and forth, cutting its banks in one place and building sand bars in another.

DEMAND FOR NAVIGATION

The growth of the railroads ended nineteenth century navigation on the Missouri, but as cities and industries were located on the floodplain, local interests began to seek river-control works which would enable low-cost waterways transportation and at the same time halt the threat to riverbank erosion. From 1920 to 1947 the Nation's inland waterways increased their freight ton-miles from 6 to 34 billion annually, and Missouri Basin interests wanted to share in that growth.

The navigation project consists of combining the many small channels into one stabilized, comparatively deep one by concentrating the flow and shaping it into smooth, easy bends so that the scouring action of the flowing water will maintain the channel. Measures used include wooden piling driven into the riverbed—so-called permeable dikes—cut-off channels to eliminate long, sharp bends; dams to close off secondary channels; and protective stone revetment along the banks. Constant attention is required to protect completed work against the vagaries of the river. Deterioration of some of the structures during World War II and limited maintenance since then has created a large backlog of this type of work.

Navigation is a major program benefit, with the Inland Waterways Corporation pioneering river commerce as a 9-foot channel is developed on the Missouri.



Stabilization of the river channel by such measures as this lumber mattress, being submerged with rock, benefits navigation and protects cities and farmland.

PRESENT AND PROSPECTIVE RIVER COMMERCE

Present navigation on the Missouri is essentially a pioneering operation carried on by the Inland Waterways Corporation, a Department of Commerce agency created for such purposes in 1924.

On the Missouri since 1935, the Corporation has hauled 1,190,325 tons of bulk and merchandise freight, 231,544 tons upstream and 958,781 tons downstream.

On the incompletely controlled river many hours are lost by grounding: 364 hours in 409 boat-days of operation in 1949.

In the 1950 season, two towboats and an average of 20 barges operated on the river, establishing a new record of 157,299 tons. The 1951 flood and resulting channel damage arrested navigation development.

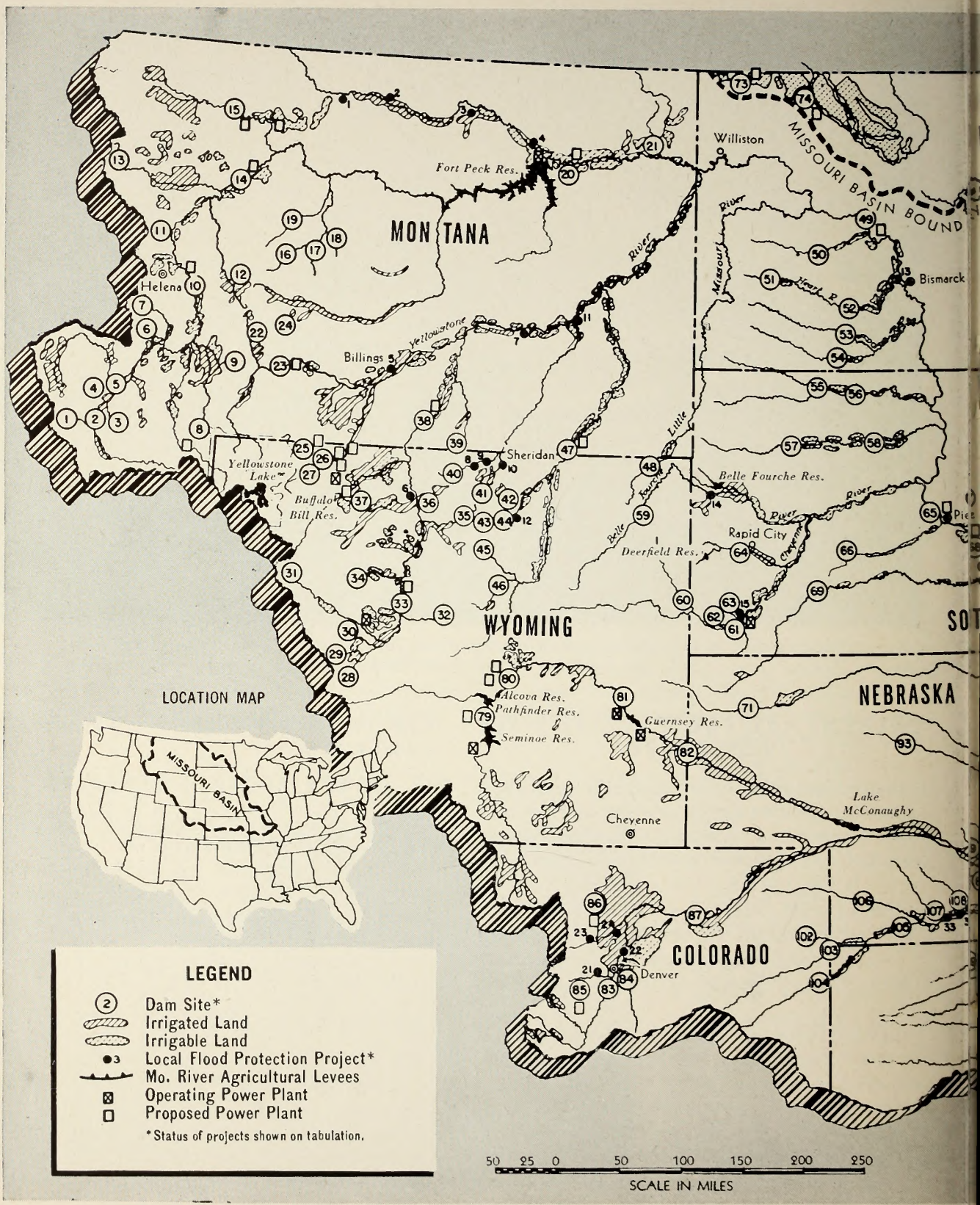
If a 9-foot channel were constructed and maintained, there is sufficient potential commerce to provide an annual traffic load of 5,000,000 tons, according to a detailed 1950 survey.

OTHER PROJECT BENEFITS

Benefits of the project to date are estimated at $217,000,000, including halting of riverbank erosion, reducing floodplain erosion, creation of new land, and protection of cities, roads, and bridges. The completed project would prevent stream-bank erosion of about 9,000 acres a year and create about 188,000 acres of accretion land, with annual benefits in excess of $24,000,000.

OTHER BASIN TRANSPORTATION

The Department of Commerce, through its Civil Aeronautics Administration and the Bureau of Public Roads, working with the States, sees that regional road plans and public airports also are related to the transportation pattern.


MONTANA
WYOMING
NEBRASKA
COLORADO
Williston
Bismarck
Billings
Helena
Sheridan
Rapid City
Cheyenne
Denver
Fort Peck Res.
Yellowstone Lake
Buffalo Bill Res.
Belle Fourche Res.
Deerfield Res.
Alcova Res.
Pathfinder Res.
Seminoe Res.
Guernsey Res.
Lake McConaughy
MISSOURI BASIN BOUND
LOCATION MAP
MISSOURI BASIN
LEGEND
Dam Site*
Irrigated Land
Irrigable Land
Local Flood Protection Project*
Mo. River Agricultural Levees
Operating Power Plant
Proposed Power Plant
*Status of projects shown on tabulation.
50 25 0 50 100 150 200 250
SCALE IN MILES

WATER RESOURCES DEVELOPMENTS

Missouri Basin Program

DAM SITES AND RESERVOIRS IN COORDINATED PROGRAM

1	A	Brenner	20.	A	Diversion Dam	45.	A	Smith	75.	A	Sheyenne	106.	C	Enders
2.	A	Clark Canyon	21.	A	Medicine Lake	46.	A	Hole-in-the-Wall	76.	A	Baldhill	107.	A	Red Willow
3.	A	Landon	22.	A	Antelope	47.	A	Moorhead	77.	A	Jamestown	108.	C	Medicine Creek
4.	A	Apex	23.	A	Absaroka	48.	A	Alzada	78.	A	Thayer	109.	A	Norton
5.	A	Reichle	24.	A	Sweetgrass	49.	UC	Garrison	79.	C	Kortes	110.	C	Harlan County
6.	A	Whitetail	25.	A	Hunter Mountain	50.	A	Broncho	80.	C	Kendrick Project	111.	*	Lovewell
7.	A	Bernice	26.	A	Thief Creek	51.	C	Dickinson	81.	A	Glendo	112.	*	Milford
8.	A	Eldridge	27.	A	Sunlight	52.	C	Heart Butte	82.	C	North Platte Project	113.	UC	Kirwin
9.	A	Beacon	28.	A	Onion Flat	53.	A	Cannonball	83.	A	Chatfield	114.	A	Webster
10.	UC	Canyon Ferry	29.	A	Soral	54.	A	Thunderhawk	84.	C	Cherry Creek	115.	A	Glen Elder
11.	A	Wells	30.	A	Raft Lake	55.	C	Shadehill	85.	*	Blue—South Platte Projects	116.	A	Wilson
12.	A	Newlan	31.	A	Du Noir	56.	A	Blue Horse	86.	UC	Colorado—Big Thompson Pro ects	117.	C	Cedar Bluff
13.	A	Sun Butte	32.	A	Badwater	57.	A	Bixby	87.	A	Narrows	118.	C	Kanopolis
14.	A	Portage	33.	C	Boysen	58	A	Green Grass	88.	*	Plum Creek	119.	A	Tuttle Creek
15.	A	Tiber	34.	A	Anchor	59.	C	Keyhole	89.	*	Bison	120.	*	Perry
16.	A	Hobson	35.	A	Lake Solitude	60	A	Edgemont	90.	*	Amherst	121.	*	Pattonsburg
17.	A	Ross Fork	36.	A	Red Gulch	61.	C	Angostura	91.	*	Cairo	122.	*	Trenton
18.	A	Snowy	37.	A	Oregon Basin	62.	A	Cottonwood Springs Creek	92.	*	Bellwood	123.	*	Mercer
19.	A	Stanford	38.	A	Yellowtail	63.	UC	Cold Brook	93.	*	Mullen	124	*	Braymer
			39.	A	Little Bighorn	64.	A	Pactola	94.	*	Rockville	125.	*	Linneus
			40.	A	Scuth Fork	65.	UC	Oahe	95.	*	Sherman	126.	*	Brookfield
			41.	A	Willow Park	66.	A	Philip	96.	*	Davis	127.	*	Rathbun
			42.	A	Lake De Smet	67.	A	Blunt	97.	*	Cushing	128.	*	Pomona
			43.	A	Triangle Park	68.	A	Big Bend	98.	*	Pibel	129.	*	Melvern
			44.	A	Bull Creek	69.	A	Rocky Ford	99.	*	Loretto	130.	*	Garnett
						70.	UC	Fort Randall	100.	*	Schuyler	131.	*	Hillsdale
						71.	C	Mirage Flats	101.	*	Rosedale	132.	*	Fort Scott
						72.	UC	Gavins Point	102.	A	Wray	133.	*	Hackleman Corner
						73.	A	Crosby	103.	A	Pioneer	134.	*	Stockton
						74.	A	Des Lacs	104.	C	Bonny	135.	A	Pomme de Terre
									105.	UC	Swanson Lake	136	*	Kasinger. Bluff
												137.	A	Richland
												138.	*	Rich Fountain

LOCAL FLOOD PROTECTION PROJECTS

1	A	Havre	16	UC	Kenslers-Miners Bend	26.	C	Pierce
2.	A	Harlem	17.	A	Sioux City	27.	A	Tilden
3.	A	Saco	18	A	Little Sioux River	28.	A	Battle Cre
4	C	Glasgow	19.	C	Omaha	29.	A	Norfolk
5.	A	Billings	20.	C	Council Bluffs	30.	A	West Point
6	A	Greybull	21	A	Morrison	31.	A	Waterloo
7.	C	Forsythe	22.	A	Platte River Levees	32.	C	Hamburg
8.	A	Dayton	23.	A	Boulder	33	C	Indianola
9.	A	Monarch	24.	A	Erie	34.	C	Bartley
10.	A	Sheridan	25	C	Schuyler	35.	C&A	Topeka
11.	A	Miles City				36.	UC	Stonehou Creek
12.	A	Buffalo				37.	UC	Kansas Citys
13.	C	Mandan				38.	UC	Charlton River
14.	C	Belle Fourche						
15	C	Hot Springs						

KEY

C—Completed.

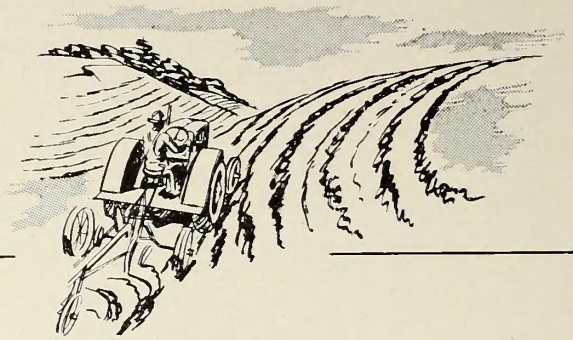
UC—Under construction.

A—Authorized.

*—Considered in lieu of or in addition to authorized project.

Note: Projects numbered in downstream order.

THE BASIN LAND PROGRAM



The land program involves all the 340,000,000 acres that make up the farms and ranches, the National and State forests, the public domain, and the Indian lands in the Missouri Basin. These are the watershed lands on which the rains and snows fall before they run off to form the Missouri and its tributaries.

The Missouri River Basin Agricultural Program was prepared in 1949 by the Department of Agriculture, with the aid of State agricultural agencies and the land-grant colleges. Participating were nine Department of Agriculture agencies: the Agricultural Research Administration, Bureau of Agricultural Economics, Extension Service, Farm Credit Administration, Farmers Home Administration, Forest Service, Production and Marketing Administration, Rural Electrification Administration, and the Soil Conservation Service.

BENEFITS

A stable foundation for agriculture in a region where drought is an unusually high risk is a primary target of the program, but it also will contribute to flood control in the major and minor valleys. Assistance will be given in integrating into the present agricultural pattern the more than 5,000,000 acres of new irrigation development. The program will enlarge the benefits from large public investment in reservoirs and other engineering works, protecting these works and giving them longer life, and at the same time help farm families to make better use of the expected benefits.

LANDOWNERS' ROLE

A cardinal principle of the program is that conservation and use of land and water must be be dealt with as inseparable. Farmers and ranchers are expected to assume primary local responsibility for their programs, thereby becoming active participants in the Basin development.

Provision is made to work with each farmer and rancher in applying the proper practices and land-use measures. This effort will be concentrated first in the most critical watersheds and expanded as rapidly as possible. The public will share in the costs through provisions for assistance in the form of direct aids, technical services, education and information, credit, and research. Landowners will provide a fair proportion of the cost of conservation materials and equipment. They will also bear costs of seedbed preparation, seeding, labor, and maintenance of structures.

In its broad scope, the agricultural program will not only safeguard the Basin's fertility against depletion but also will increase the productivity of this vital area of the Nation. Timber production can be more than doubled, and an increase of 30 percent in crop and pasture production is anticipated over the next 30 years. This would add about 5 percent to the national output and help meet the demands of an expected population increase of 40,000,000 people by 1980.

Measures needed on Basin watershed lands and forests have been inventoried and included in the program, to be applied in appropriate combinations and in relation to land capabilities and needs.

CROPLAND

On the 113,000,000 acres of cropland, almost 2,000,000 miles of terraces will be installed. This would protect 20,000,000 or more acres of sloping cropland from erosion, help conserve moisture, reduce siltation and reduce the rate of water runoff. Sod waterways and protected terrace outlets will be installed. Another 36,000,000 acres will need to be farmed on the contour instead of up and down the slopes. Strip cropping is needed on 20,000,000 acres to protect against wind and water erosion, and stubble mulching on 34,000,000 acres of strip-cropped and contoured land to increase water absorption. Thousands of erosion-control structures such as small dams, diversion terraces, roadside and stream bank erosion control are necessary parts of the job.

RANGE AND PASTURE

On the 157,500,000 acres of privately owned range and pasture land, measures to increase production of livestock forage and halt wind and water erosion are needed. This involves reseeding 17,500,000 acres and building 407,000 ponds for livestock water, to expand grazing and protect the range by distributing livestock more evenly. Ditches, dikes, and terraces to spread floodwaters from small water courses over approximately 2,300,000 acres of range land will increase hay and grazing. These practices, together with grasshopper control, elimination of poisonous weeds, fire protection, and better grazing management, will give tremendous increases in range and pasture production.

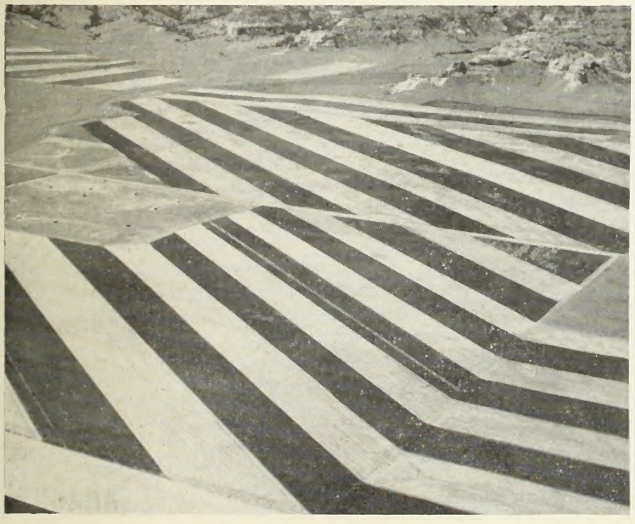
FORESTS

On the 45,000,000 acres of forest and forest-range lands, more intensive management is needed to increase timber production, to improve range conditions, to increase recreational use, and to gain benefits from watershed protection and wildlife development. This will require tree planting on about 5,000,000 acres in National and State forests and on private forest lands, and expansion of nurseries to provide planting stock. An additional 245,000 miles of shelterbelts and 750,000 acres of windbreaks are proposed on farms and ranches. Improved fire protection, disease and insect control, and recreational facilities within the forests are planned. Immediate increases in the harvesting of timber can be attained by constructing access roads to areas with merchantable stands of timber. Continued timber production will require keeping fires to a minimum, planting where necessary and proper cutting, logging, and management.

SMALL WATERCOURSES

On hundreds of small watersheds, structures and stabilizing measures in the small watercourses are needed to retard temporarily the damaging runoff, so that it will pass through tributary channels without overflowing bottom lands. In many areas, gully sys-

Diagonal strip cropping is used to prevent wind erosion. Strips are oriented across the prevailing wind, as on this farm near McGrew, Nebr.



The cure for erosion—contour farming and terracing hold rainfall and reduce water run-off on this farm near Ralston, Nebr.

tems have been caused by unstable channels. The recommended measures will reduce reservoir siltation, extending the life of the structures.

These stabilizing measures include: (1) between 14,000 and 16,000 small upstream floodwater-retarding structures and 400 to 600 desilting basins, providing temporary storage for 4,800,000 acre-feet of water to be passed downstream over several days rather than in the form of an immediate flash flood; and (2) small dams with drop outlets to control head-cutting gullies, a stream-channel improvement to reduce bank cutting, and other small structural works that usually are more than landowners can do without public assistance.

AID TO IRRIGATION

Improved efficiency in water and land use on the 5,000,000 acres now irrigated and the more than 5,000,000 acres proposed for new irrigation is another major program goal. Farmers and irrigation enterprises will be assisted in laying out efficient water-distribution and adequate drainage systems and in adopting land-leveling, and cropping practices. Technical assistance would be provided, as would credit to those who need loans; this part of the program is to be closely coordinated with the Bureau of Reclamation.

DRAINAGE

More than 5,800,000 acres are in need of drainage, and 1,500,000 of these lie behind levees now built or in prospect. Individuals and drainage districts will be assisted in laying out efficient systems. Planning for drainage behind levees will be coordinated closely with the Corps of Engineers.

RESEARCH

In addition to applying tested conservation techniques, the program provides for research to improve these techniques. It also will expand agricultural-extension work in areas where new irrigation and development problems require farm people to learn new methods quickly. Loans to farmers will assist in the large investments necessary to change from dry-land to irrigation farming. Expanded soil surveys and other investigations will reduce trial-and-error losses

Grazing leases on much of the 19½ million acres of Basin public domain lands enable ranchers to graze some 350,000 cattle, 2 million sheep and 35,000 horses each year.

resulting from efforts to use land for unadapted purposes.

PUBLIC DOMAIN LAND PROGRAM

Of the vast Basin area once contained in the Louisiana Purchase, 19,425,000 acres still remain in the public domain. Located principally in Montana and Wyoming, that land is the responsibility of the Bureau of Land Management of the Department of the Interior. It is scattered in a checkerboard pattern of tracts among private, State, and county holdings. Each year approximately 7,500 ranchers graze some 350,000 cattle, 2,000,000 sheep, and 35,000 horses on the land, which also supports 25,000 deer, 3,500 elk, 35,000 antelope, and about 100 moose. Two-thirds of the land is organized into 12 grazing districts.

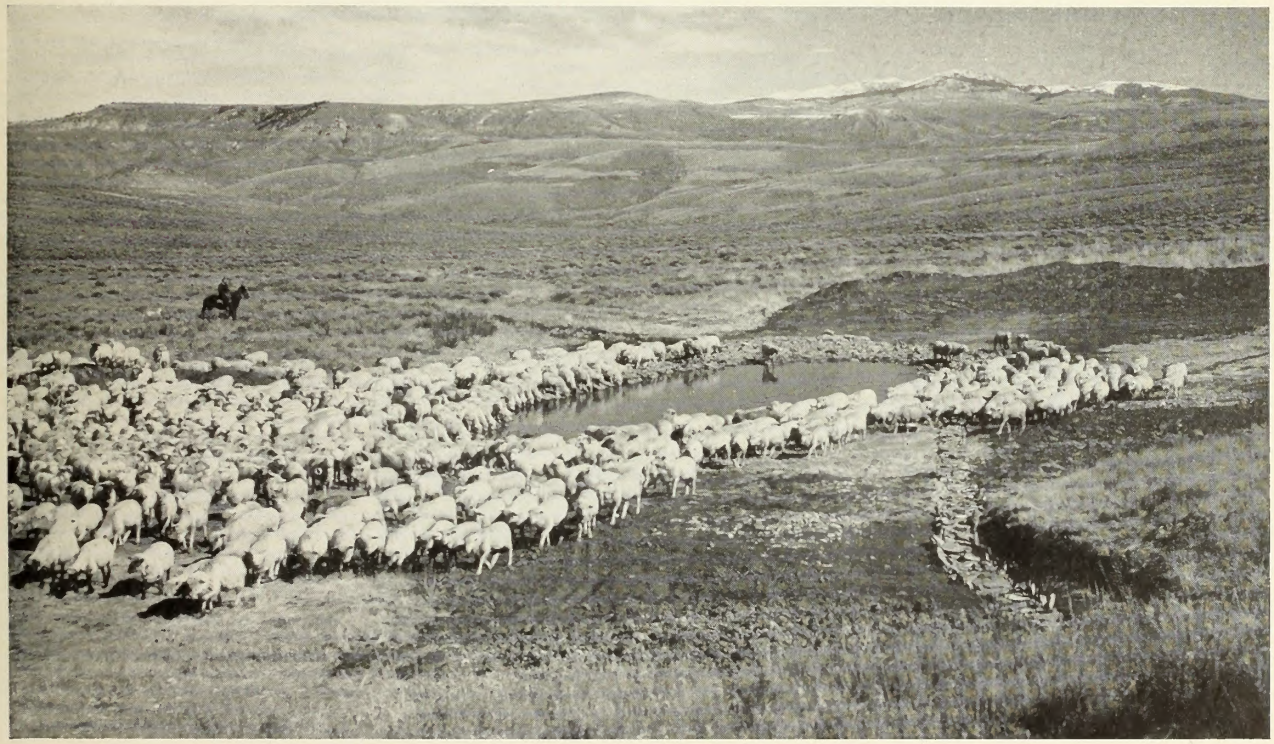
Some of this land is the least desirable in the Basin, but as such it contributes a disproportionate burden of runoff and silt and so offers a special problem. The Bureau of Land Management classifies the land as to physical use capabilities, in terms of soil, topography and climate, and is engaged in developing and managing these lands and the resources thereon in harmony with the comprehensive resource program. So far the reconnaissance surveys are complete on 13,250,000 acres, with detailed classification on 6,500,000 acres.

INDIAN LAND PROGRAM

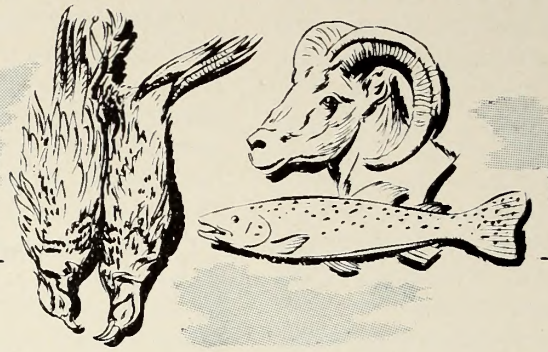
A third Basin land development program involves the Indians living on the 15 reservations in the Basin. Many of the Indians historically have chosen to live along the river bottoms. Approximately 376,500 acres of the 14,493,000 acres of Indian land in the Basin would be needed for reservoir right-of-way. This involves the relocation of about 700 families.

This land-management problem and the related one of developing or rehabilitating irrigation acreage on the reservations is the concern of the Bureau of Indian Affairs of the Department of the Interior. In 1950, Congress approved a compensation plan for some 280 families on the Fort Berthold, N. Dak., reservation who will be dislocated by the Garrison Reservoir. Restudy of irrigation possibilities is under way on 11 reservations. There are now about 180,000 acres of Indian land under irrigation.

Sheep are a major source of agriculture income in the western Basin area. Forest range lands also provide forage for deer and other wildlife.



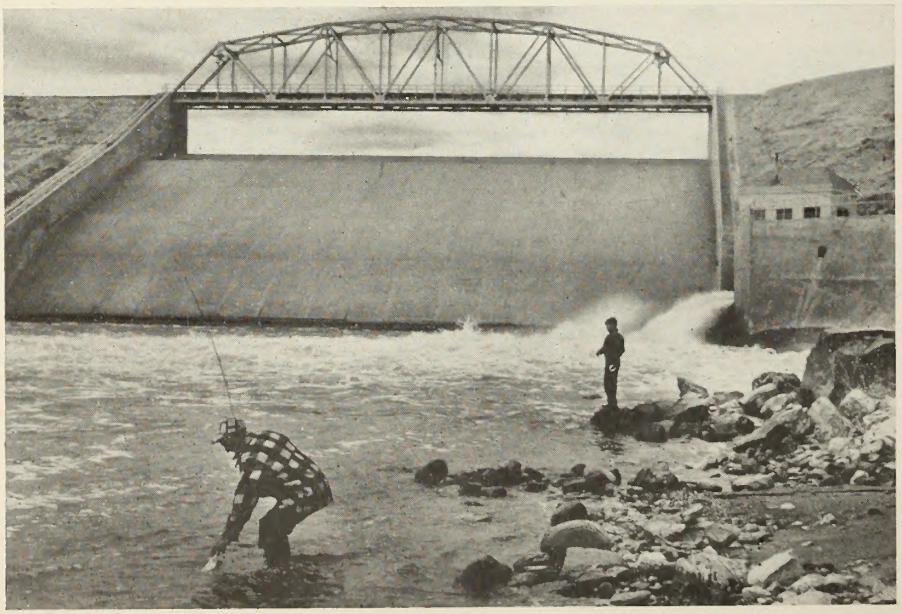
FISH AND WILDLIFE



The construction of reservoirs having a water-surface area of more than 1,000,000 acres will have a profound effect on Basin fish and wildlife resources, a problem which is the responsibility of the Fish and Wildlife Service of the Department of the Interior and the respective State game and fish departments. Basin States' agencies in 1949 sold 1,737,000 hunting licenses and 2,072,000 fishing permits, and the activities of sportsmen are increasing.

BASIN WILDLIFE RESOURCES

A substantial share of the Nation's big game is located in the Basin. There live half of the elk, two-thirds of the antelope, practically all of the grizzly bear and more than half of the bighorn sheep. In the region are found many types of game birds, including grouse, prairie chicken, quail, mourning dove, partridge, pheasant, and ducks and other migratory waterfowl.



Better fishing is one of the benefits of the program. Here an 18-inch trout is pulled from the Milk River below Fresno Dam in Montana.

In 1946 the Fish and Wildlife Service began a Basin-wide study of the effects of reservoirs on fish and wildlife. It now has completed 143 reports, involving 115 projects, and has drawn even with the construction pace.

The four-point plan of the Service involves protecting existing resources, reclaiming lost habitat and creating new, developing and encouraging sound management practices, and formulating a comprehensive development program. The objective now is to have detailed studies available on the effects on fish and wildlife while a reservoir still is in the blueprint stage.

Fish and wildlife resources such as these geese, shown at a game refuge, will benefit from the new reservoirs. Many new wildlife refuges and hatcheries are planned.

RESERVOIR EFFECTS

Studies so far indicate that reservoirs generally benefit fishlife, and while some reservoirs have adverse effects on wildlife, over-all benefits outweigh losses. Appropriate wildlife habitat is planned for all reservoir lands where warranted.

The first planting of shrubbery and trees at reservoir sites was carried out in 1949 and 1950 at five sites, and similar work is planned at other sites where conditions permit. Creel censuses, to determine the number and species of fish taken, have been conducted by Federal and State agencies on several lakes, reservoirs, and streams.

In the Basin in 1951 were 38 national wildlife and 72 easement refuges and 4 warm-water fish and 17 trout hatcheries, and additional refuges and hatcheries are planned. The Service also enforces Federal game laws.

PROGRAM OBJECTIVES

The Service seeks a more accurate evaluation of fish and wildlife resources, including their monetary worth; expanded inventories of migratory waterfowl to determine the value of artificial bodies of water, and further data on the effect of irrigation on wildlife.

In all its activities the Service works closely with the various State game and fish commissions, which have primary responsibility for wildlife and fisheries management within their borders. The States also, in most cases, maintain and operate the wildlife features adjacent to reservoirs.

RECREATION

RESERVOIR SITE PLANNING

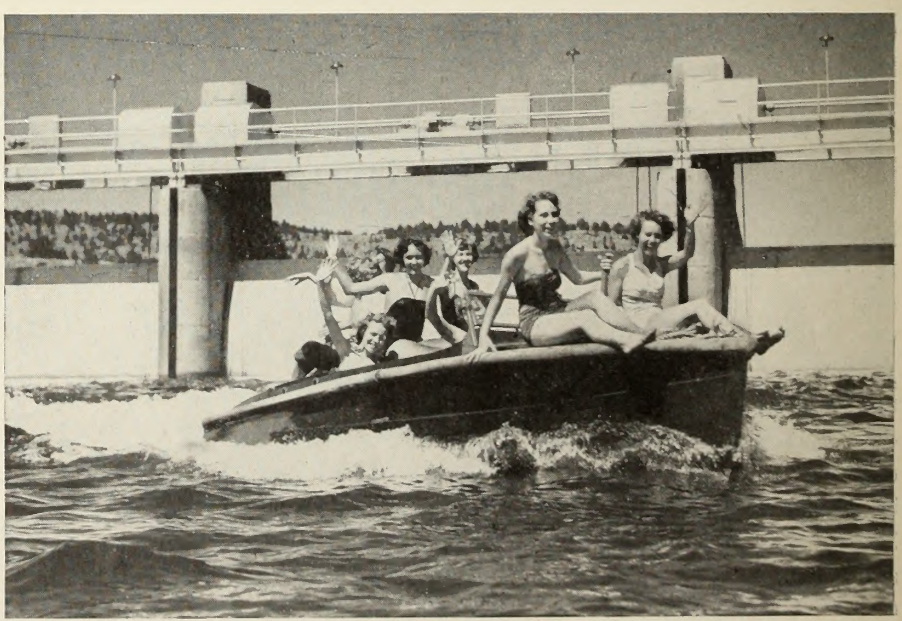
For many Basin residents their most direct contact with the development program will be through recreational features at the reservoirs for the benefit of campers, picnickers, fishermen, swimmers, boaters, and sightseers. Plans for such development at Bureau of Reclamation reservoirs are prepared by the National Park Service of the Department of the the Interior. The Corps of Engineers plans its own facilities, with the National Park Service as consultant. Recreational facilities had been installed at 5 reservoirs as of 1951. The National Park Service has completed 88 reports on recreational possibilities at various sites. On all reservoirs, the States cooperate in recreation planning, construction, and operation.

In the Basin the Service also administers 4 national parks, 12 national monuments, the Rushmore Memorial, and the Roosevelt Memorial Park.

The National Park Service has an agreement with the Smithsonian Institution whereby the latter investigates the archeological and paleontological significance of potential reservoir sites and recovers artifacts left by early man.

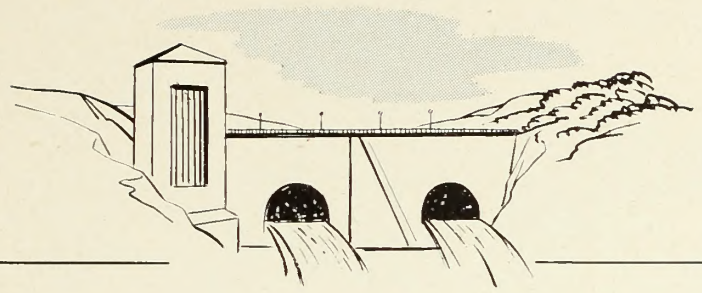
NATIONAL FOREST RECREATION

The national forests along the Basin's western rim have seen increased recreational use, but the available facilities are not keeping pace with demand. The Department of Agriculture plan recommends expanded recreational development in the national forests.



Recreational benefits of the program are available to all residents of the Basin. This group is enjoying a holiday on the Angostura reservoir. Dam structure can be seen in background.

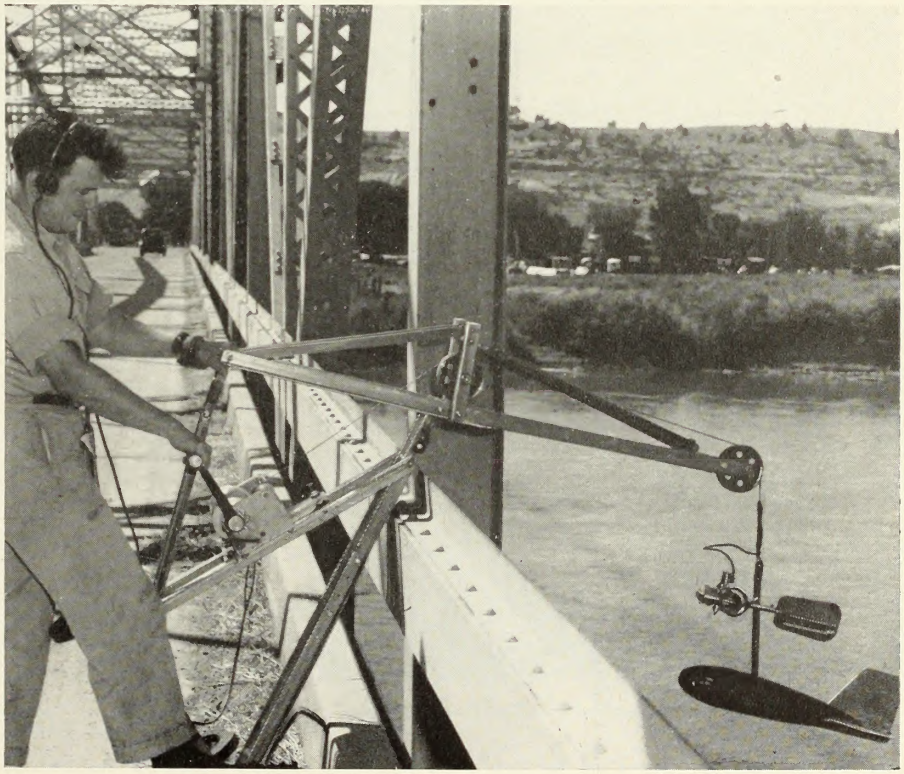
WATER SUPPLY



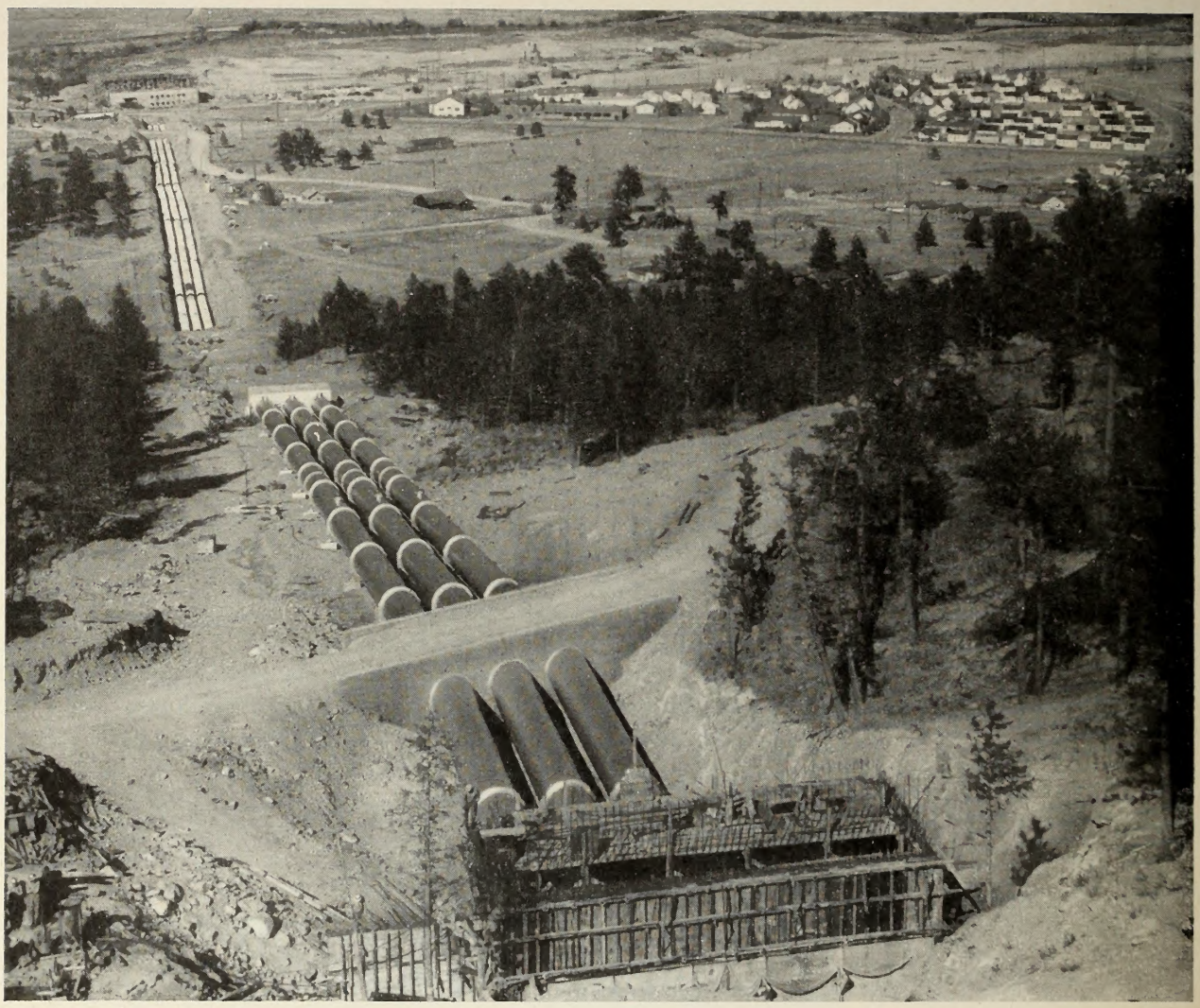
In April 1951 a subcommittee of the Inter-Agency Committee completed a detailed analysis on the adequacy of flow. The group found that the average annual flow of the Missouri at Sioux City was approximately 24,500,000 acre-feet, whereas requirements under the comprehensive plan would range from 16,530,000 acre-feet in 1960 to 22,746,000 acre-feet by the year 2000.

The subcommittee concluded, on the basis of available data, that the regulated water supply of the Missouri River will be adequate except on rare occasions for all purposes including irrigation and other agricultural purposes as planned above Sioux City, downstream water supply and sanitation purposes, satisfactory navigation below Sioux City, and substantial power generation. This conclusion confirms the findings of the independent investigation conducted in 1944 by the Missouri River States Committee through the nine States' water engineers as well as other studies made prior to the authorizations of the plan. The subcommittee also suggested the need for continuing study.

Under the Basin development program, regulation of stream flow through reservoir control will bring substantial other downstream benefits such as im-



Stream gaging measures depth and flow rate of Basin rivers. A continuous record of water supply is obtained from 810 automatic stations.



Penstocks drop the waters downhill toward the Estes power plant of the Colorado-Big Thompson project, from there to towns and farms for municipal and irrigation use.

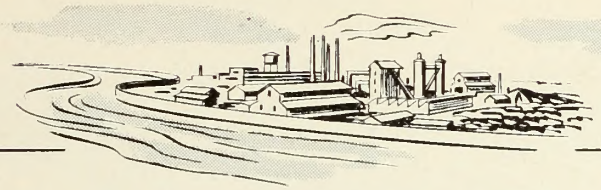
proved water supply for municipal and industrial use and reduced stream pollution.

Problems of water supply and pollution are of particular importance in the Lower Basin, where nearly 1,500,000 persons depend on the Missouri for drinking water. Not only can low flow or high pollution content endanger water supplies, but floods often threaten waterworks pumping plants.

Solution of the problem of municipal and industrial water supply must consider the types of use requiring assistance. Organized waterworks are found in both large and small municipalities. As the Basin develops under the program, many small towns will grow to appreciable size and will need an ample supply of water. New or expanded industries will also require an assured supply of water.

The O'Mahoney-Milliken amendment in the Flood Control Act of 1944 declared a priority of beneficial consumptive use of water in the Upper Basin over navigation use downstream. In March 1950, by making a policy determination, the Inter-Agency Committee recognized the necessity of ample water for domestic, municipal, industrial, and stream sanitation needs in the Lower Basin.

PUBLIC HEALTH AND STREAM SANITATION

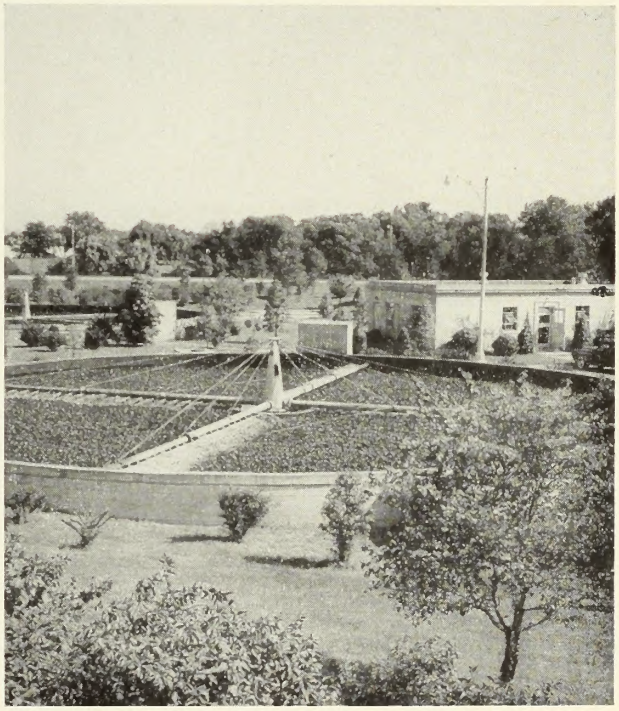


The objective of the health agencies, State and Federal, is maximum utilization of the development plan for the improvement of environment as related to health. The program holds much promise for a better environment in localized areas. The Public Health Service of the Federal Security Agency, working in close cooperation with the State health departments, serves in a consulting capacity in matters relating to public health and water-pollution control and makes pertinent investigations and studies relating to the development program.

In 1943 the Public Health Service made a preliminary evaluation of pollution in the lower Missouri River and estimated minimum flows necessary at that time for stream sanitation. In 1947 the Public Health Service became actively interested in the broad features of land and water-resource development in the Basin and inaugurated close liaison with State and Federal agencies regarding the health aspects of the development. The passage of the Federal Water Pollution Act of 1948, and the attendant responsibility of developing in cooperation with the States a comprehensive program of water-pollution control, facilitated cooperative work with State and other Federal agencies interested in the Basin program.

As a result of these cooperative efforts, subbasin investigations of water-pollution control in the Kansas, North Platte, South Platte, Lower Platte, and Niobrara Subbasins have already been completed and reports written. With the completion of reports for the remaining nine subbasins, basic work will have been completed preliminary to the development of a comprehensive program of water-polution control for the Missouri Basin.

There are at present 979 municipal and 188 industrial sources of pollution contributing to the Missouri River and its tributaries. The total pollution load discharged into the Basin's waterways in terms of equivalent numbers of people is equal to about



Modern sewage-disposal plants, such as the one shown here, are essential to prevent pollution and permit full utilization of the water supply.

11,000,000 persons. Of this amount, 8,500,000, or over 70 percent, is industrial pollution, principally from packing houses, beet-sugar refineries, and oil refineries. About 53 percent of the urban population of the entire Basin lives in areas served by some degree of sewage treatment; however, only 15 percent of the population lives in localities provided with adequate treatment.

The health agencies are also interested in sanitation of recreational areas and construction camps, municipal and industrial water supply, mosquito control, the sanitary quality of irrigation waters, and other sanitation problems. Close cooperation with the planners and constructors of the Missouri River Development Program will make possible the achievement of the objectives of the health agencies.

Concrete flood walls protect urban and industrial areas from inundation and resultant public health problems.

MINERAL RESOURCES

The Basin contains important deposits of fuels and metals, industrial minerals, and construction materials, many of which, though extensive, have lain virtually untapped for lack of power, local demand for mineral products, or adequate methods of beneficiating the ores, many of which are low-grade. Increased electric power under the Basin program and improved mining technology should make development of these deposits economically feasible.

MINERAL RESOURCE AGENCIES

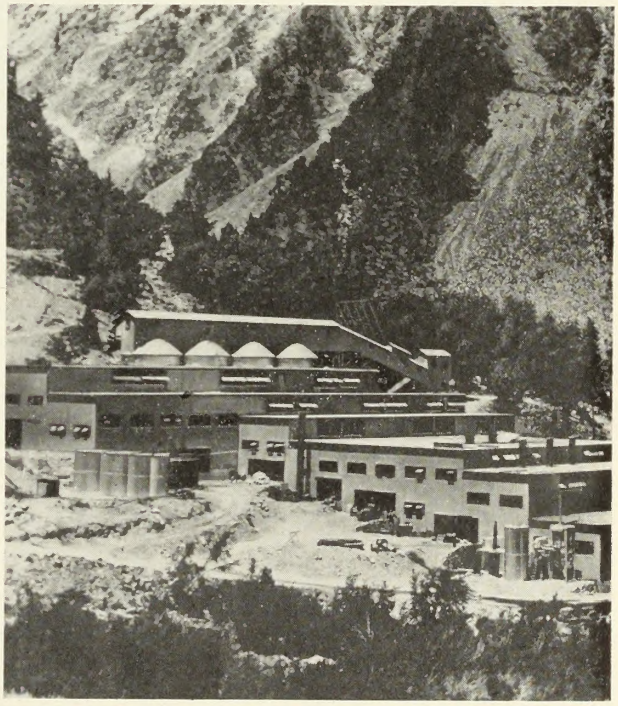
The United States Geological Survey and the Bureau of Mines of the Department of the Interior have a joint responsibility to further industrial growth by providing basic information about these deposits. The Survey searches for and appraises mineral reserves as to over-all tonnage and grade and conducts research in the science of ore-finding. The Bureau of Mines determines the quantity and quality of recoverable material and investigates the technology and economics of mining.

All of the Basin States except one have geological surveys performing similar duties within their jurisdiction.

MAPPING OF DEPOSITS

From sampling to determine surface extent of deposits and by surveying subsurface conditions, the Geological Survey prepares maps showing the location of mineral resources. These include the immense Basin coal reserves (comprising 40 percent of the Nation's supply), oil and gas in Wyoming, Montana, Kansas, and Colorado, and metals such as chromite, titanium, iron, lead, and zinc; nonmetallic minerals such as sulphur, phosphate, barite, bentonite, silica sand, and the pegmatites, and construction materials such as sand, gravel, and stone.

The Bureau of Mines is preparing a Basin-wide abstract of mineral resources, a county-by-county study of present production and possibilities, and a survey of the availability of solid fuels for 45 potential thermal-power sites.



Mines in the mountains tap the rich mineral resources of the Basin. Many known deposits have not yet been opened up because of the distance from processors and consumers.

Strip mining of coal is successful in the Missouri Basin because of the thickness of veins, as in this Wyoming pit. The Basin has two-fifths of the Nation's reserves.

LIGNITE RESEARCH

Since Basin coal is of low-heating quality, the Bureau of Mines, at its Grand Forks, N. Dak., laboratory, seeks means of expanding uses of lignite-type coals. The Bureau also has a bituminous-coal research and utilization laboratory in Denver.

COMMERCIAL DEVELOPMENT

Development of a large-scale synthetic fuel industry based on coal and oil shale appears likely in the Basin, as coal reserves far exceed the Nation's present proved reserves of petroleum. The Bureau of Mines at its Louisiana, Mo., demonstration plant, has produced Diesel fuel from North Dakota lignite tar. It is also refining oil shale at another plant in Rifle, Colo.

Large phosphate reserves in Montana and Wyoming offer promise of a fertilizer industry. Private commercial development already is under way, following Bureau of Mines research at two sites.

Also within the Basin are important reserves of manganese and chrome, in addition to other minerals. Many of these occur in marginal deposits, however, far from present processing or consuming centers.

INDUSTRY AND BUSINESS

A diversified Basin economy is sought to reverse the long-time trend toward a possible ultimate loss of population. From 1940 to 1950, for example, the eight Basin States other than Iowa and Minnesota accounted for only 403,124 of the Nation's population gain of 19,028,086.

As the development of the natural resources of the Basin progresses, it is to be expected that new industrial and commercial opportunities will be opened up. The job of helping to earmark these opportunities and of assisting States, communities, and private enterprise in taking advantage of them rests with the Department of Commerce. Increased industrial development based on the products of mines and farms will be accompanied by additional expansion of markets, transportation facilities, construction and retail activity, and the many service occupations.

Planning for future economic development requires unified projections of population, employment, and income. Through its Bureau of the Census and the Office of Business Economics, the Department provides statistical and analytical services important to planning by business and by public agencies. The Area Development Division of the Office of Industry and Commerce aids communities and States directly in their planning of industrial expansion. Other agencies of the Department—including the Bureau of Public Roads, Civil Aeronautics Administration, Coast and Geodetic Survey, and Weather Bureau—provide engineering and scientific data necessary to the proper execution of Basin projects.

ROADS AND HIGHWAYS

The Bureau of Public Roads is taking an increasingly important part in both the planning and operational aspects of Basin development. Close coordination between the Bureau, the State highway departments, and the other Basin agencies is imperative, to assure that highway improvements are not placed where they will be made useless by reservoirs or other projects, that existing highways are relocated where necessary, and that the road net is planned to give greatest encouragement to Basin industrial and agricultural expansion.

PLANNING DATA

In addition to social and economic data, sound engineering planning of the program has required a wealth of basic physical data-inventories, maps, and measurements. Several Federal agencies, assisted in many cases by State cooperation, carry forward this vital task.

GEODETIC SURVEYS

The Coast and Geodetic Survey of the Department of Commerce has completed 53 percent of its horizontal control program and 25 percent of its vertical control program in the Basin, involving establishment of monumented points and precise determination of latitude and longitude, distances, azimuths, and elevations. These points serve other agencies as basic con-

trols for mapping and engineering surveys. Recent Geodetic field work in the Basin has been in areas where other agencies have indicated special needs.

RESURVEYS

Cadastral surveys, the relocating of land lines and section corners, is a responsibility of the Bureau of Land Management of the Department of the Interior. Many of the markers left half a century ago have been obliterated. Requirements for the purchase of reservoir areas and the layout of irrigation farms have pushed this work. Nearly 5,000,000 acres have been resurveyed, and resurveys on an additional 9,500,000 acres are authorized.

TOPOGRAPHIC MAPS

Topographic maps portray the physical character of the terrain in three dimensions, showing the intricate detail of drainage, major man-made developments such as roads and buildings, and elevations, as shown by contour lines indicating the form of hills and valleys. These maps are valuable in locating sites for roads, dams, canals, pipelines, and transmission lines, defining areas suitable for irrigation and other development, delineating reservoirs and their storage capacity, classifying land use, and studying development of resources such as ground water, oil, gas, and minerals.

The United States Geological Survey of the Department of the Interior, with State cooperation, has completed since 1945 the field work for mapping approximately 40,000,000 acres in the Basin, of which more than 6,000,000 acres has been published. River-survey maps totaling 2,900 lineal miles also have been published. Completion of the entire job, however, will require 20 years at the present rate.

STREAM GAGING

Measurement of the Missouri and more than 100 of its tributaries is carried on continuously at approximately 810 stream-gaging stations, operated by the Geological Survey, the States, the Corps of Engineers, and the Bureau of Reclamation. The stage and volume of discharge are recorded daily.

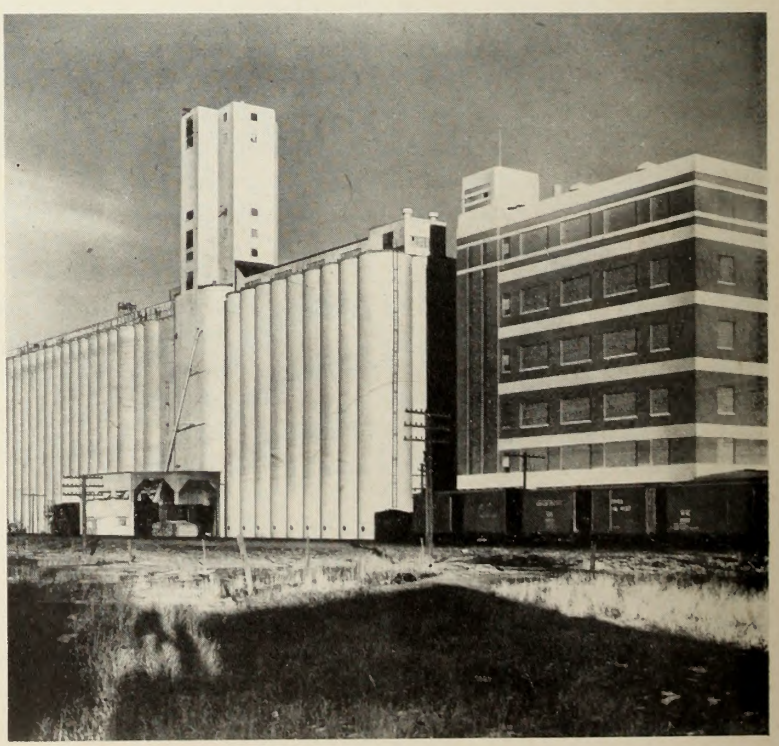
GROUND WATER

Ground water is the chief source of public, domestic farm, and livestock water in the Basin, in addition to its use for irrigation, air-conditioning and industrial supply. Well levels have declined locally in some parts of the Basin in recent years, but in other parts underground reservoirs are ample for increased development.

Ground water surveys by the Geological Survey in cooperation with the States, are under way in 50 Basin areas with periodic checks of 3,300 observation wells. Hydrologic properties of water-bearing formations also are studied.

SEDIMENT STUDIES

Studies of erosion loss, movement of sediment and resulting stream channel changes are carried on



More food processing plants, such as this elevator and flour mill, will be built to handle the increased agricultural produce of the Basin resulting from irrigation.

through 96 measuring stations in 24 subbasins. The chemical quality of surface and ground waters is studied to determine their suitability for various uses.

GEOLOGIC MAPS

Geologic maps depict the broad geologic features of the area, including information on the surficial deposits and bedrock. They are useful in: (1) the search for new minerals and mineral fuels, (2) classifying soils, and (3) appraising ground-water resources. Less than 10 percent of the Basin is covered by adequate geologic maps. The goal of the Geological Survey is to cover the Basin within 30 years.

SOIL SURVEYS

Soil maps covering about 30 percent of the Basin land area have been published so far to provide a sound basis for farm planning. Soils vary widely in their characteristics, which should be known before investments are made to change their use. Some respond generously to irrigation or drainage while others only waste such investment. Such knowledge is being compiled by the Agricultural Research Administration and the Soil Conservation Service of the Department of Agriculture, the Bureau of Reclamation, and the State Agricultural Experiment Stations.

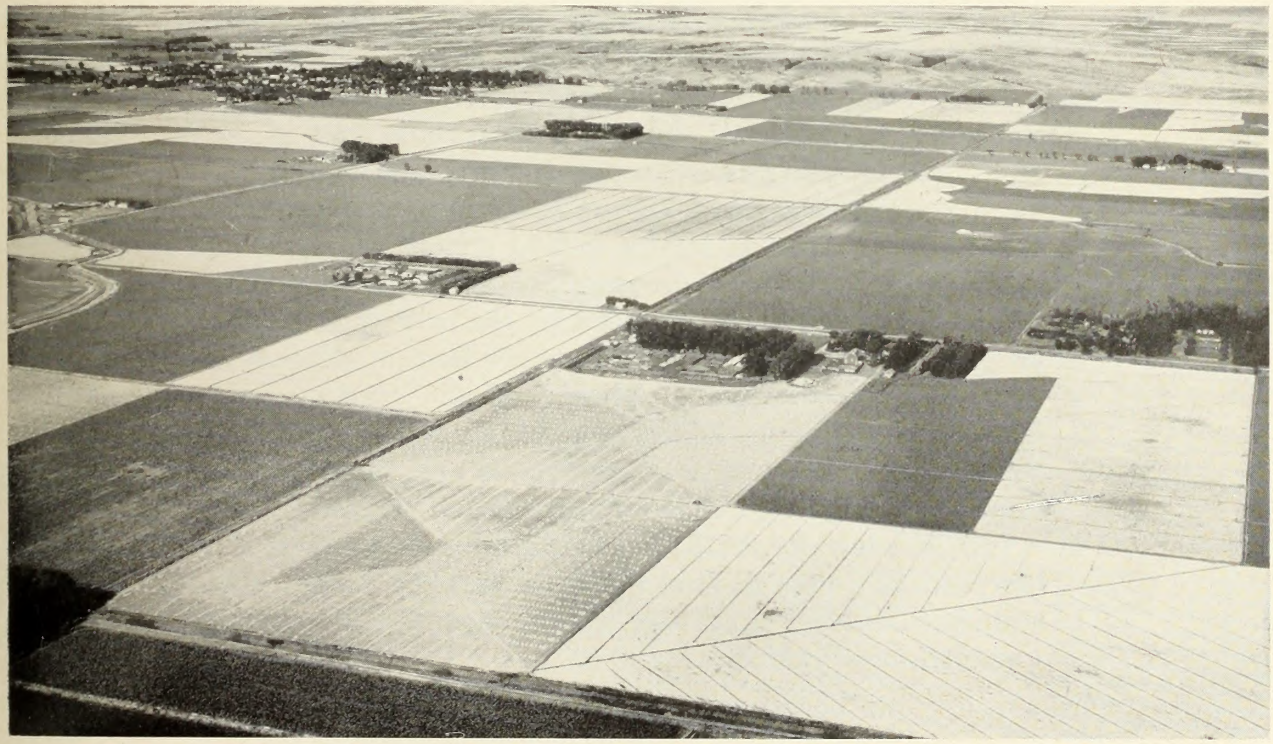
SNOW SURVEYS

Snow surveys now exist on major Basin tributaries as a guide to expected water yield for reservoir operation and irrigation planning. Water supply forecasts, needed by farmers and irrigation districts as cropping guides, are prepared cooperatively by the States, Forest Service, Soil Conservation Service, Bureau of Reclamation, and the Geological Survey.

WEATHER BUREAU FORECASTS

The Weather Bureau, in addition to its weather-forecasting service, proposes to extend its Basin flood-warning service by the establishment of more river forecast centers. Water-supply forecasts, for users dependent on winter precipitation in the high Upper Basin areas, will be enlarged. The present 1,600-station hydroclimatic network in the Basin will be increased in density, and valuable data on precipitation, evaporation, soil moisture, temperature, and other factors will be published.

The final result—broad, productive fields show the new farm wealth created in the Basin. Crop returns from this reclaimed wasteland during the past year alone exceeded construction costs.



SUMMARY

The foregoing description of the Missouri River Basin Development Program shows it to be an effort of unprecedented scope and complexity to modify nature for the benefit of man. So many are the phases of the plan and so far reaching its effects, that it can hardly be grasped as a single concept. Such a program cannot be swiftly completed—some parts will require a generation or more to carry out—but the ultimate transformation of the Missouri Basin economy is a prospect to capture the imagination of all.

Giant dams and related engineering structures can yield security from recurring destructive floodwaters and at the same time provide power for new industry and more comfortable living, navigation on the lower river, and water to bring new agricultural wealth to arid regions through irrigation. The comprehensive land-treatment program can secure the Basin's agriculture against the ravages of erosion and climatic adversity and build greater farm production to serve a large population. These and the many related features to develop the Basin's other resources are designed to bring a surge of new industry to diversify and, consequently, stabilize the region's dominantly agricultural economy.

The Missouri River Basin Development Program is the blueprint of a plan to help the Basin and the Nation reap abundant benefits from the natural resources of one of America's last frontiers.

APPENDIX A—*Corps of Engineers Projects*

Reservoir	State	Stream	Status Jan. 1, 1952	Storage (Acre-Feet)	Estimated Cost
Fort Peck	Mont	Missouri	In operation	19, 412, 000	$156, 900, 000
Garrison	N. Dak	Missouri	42 percent	23, 000, 000	302, 256, 000
Oahe	S. Dak	Missouri	4 percent	23, 600, 000	317, 500, 000
Fort Randall	S. Dak	Missouri	43.5 percent	6, 300, 000	197, 300, 000
Big Bend	S. Dak	Missouri	Auth. 1944	340, 000	49, 500, 000
Gavins Point	S. Dak	Nebr.–Mo	2 percent	540, 000	60, 055, 000
Harlan County	Nebr	Republican	90 percent	850, 000	47, 133, 000
Kanopolis	Kans	Smoky Hill	Completed 1948	450, 000	12, 167, 000
Cherry Creek	Colo	Cherry Creek	Completed 1950	95, 000	14, 607, 300
Tuttle Creek	Kans	Big Blue	Planning	2, 280, 000	79, 132, 000
Chatfield	Colo	South Platte	Auth. 1950	200, 000	29, 206, 000
Red Willow	Nebr	Red Willow	Auth. 1944	43, 000	11, 075, 000
Pioneer	Kans	Arikaree	Auth. 1944	115, 000	15, 700, 000
Pomme de Terre	Mo	Pomme de Terre	Planning	575, 000	21, 922, 000
Chillicothe	Mo	Grand	Auth. 1938	2, 400, 000	55, 104, 000
Arlington	Mo	Gasconade	Auth. 1938	330, 000	23, 780, 000
Richland	Mo	Gasconade	Auth. 1938	1, 400, 000	29, 713, 000
Osceola	Mo	Osage	Auth. 1938	3, 300, 000	97, 473, 000
South Grand	Mo	South Grand	Auth. 1938	900, 000	20, 235, 000

Project	State	Stream	Status Jan. 1, 1952	Estimated Cost	
				Federal	Non-Federal
Missouri River Navigation and Stabilization.	Mo.-Kans.-Nebr.-Iowa.	Missouri	67 percent	$294, 781, 000	
Missouri River Agricultural Levees.	Mo.-Kans.-Nebr.-Iowa.	Missouri	19 percent	133, 505, 000	$11, 500, 000
Kansas City	Mo.-Kans	Mo.-Kans	80 percent	41, 805, 000	5, 835, 651
Omaha	Nebr	Missouri	Completed	5, 895, 400	362, 000
Council Bluffs	Iowa	Missouri	Completed	2, 725, 000	145, 800
Sioux City	Iowa	Missouri	Auth. 1944	1, 100, 000	40, 000
Missouri River, Sioux City to Kenslers and Miners Bend.	Nebr.-S. Dak	Missouri	38 percent	10, 005, 300	5, 000
Chariton River	Mo	Chariton	38 percent	2, 740, 000	86, 200
South Topeka	Kans	Kansas	Completed	738, 200	36, 800
North Topeka	Kans	Kansas	Auth. 1936	664, 830	114, 200
Indianola	Nebr	Coon Creek	Completed	68, 000	83, 000
Bartley	Nebr	Dry Creek	Completed	136, 600	67, 200
Lawrence	Kans	Kansas	Inactive	163, 100	118, 100
Denison	Iowa	E. Fork Boyer	Inactive	62, 000	3, 650
Hamburg	Iowa	Nishnabotna	Completed	236, 000	
Schuyler	Nebr	Platte	Completed	75, 000	
South Platte Levees and Channel Improvement.	Colo	S. Platte	Auth. 1950	28, 493, 000	2, 413, 000
Morrison	Colo	Bear Creek	Planning	615, 000	10, 000
Erie	Colo	Coal Creek	Auth. 1950	51, 000	22, 800
Boulder	Colo	Boulder	Auth. 1950	496, 000	1, 157, 000
Waterloo	Nebr	Elkhorn	Auth. 1950	96, 000	45, 000
West Point	Nebr	Elkhorn	Auth. 1950	141, 000	30, 000
Pierce	Nebr	North Fork	Auth. 1950	191, 000	46, 700
Norfolk	Nebr	Elkhorn	Auth. 1950	2, 434, 000	616, 000
Tilden	Nebr	Giles Creek	Auth. 1950	455, 000	68, 000

APPENDIX A—*Corps of Engineers Projects*—Continued

Project	State	Stream	Status Jan. 1, 1952	Estimated Cost	
				Federal	Non-Federal
Battle Creek	Nebr	Battle Creek	Auth. 1950	$312,000	$33,000
Little Sioux	Iowa	Little Sioux	Planning	4,510,000	400,000
Big Sioux Harbor	Iowa-S. Dak	Big Sioux	Auth. 1946	757,600	4,800
Fall River	S. Dak	Fall River	49 percent	4,479,000	138,200
Belle Fourche	S. Dak	Belle Fourche	Completed	37,400	4,400
Mandan	N. Dak	Heart	Completed	551,700	93,000
Beulah	N. Dak	Knife	Auth. 1944	129,800	41,400
Hazen	N. Dak	Knife	Auth. 1944	57,200	14,700
Marmarth	N. Dak	Little Mo	Inactive	21,700	39,000
Wibaux	Mont	Beaver Creek	Inactive	42,300	62,400
Forsyth	Mont	Yellowstone	Completed	265,000	15,200
Miles City	Mont	Yellowstone	Auth. 1950	1,141,000	39,000
Billings	Mont	Yellowstone	Auth. 1950	3,389,000	270,000
Sheridan	Wyo	Goose Creek	Auth. 1950	2,097,000	39,000
Dayton	Wyo	Tongue	Auth. 1950	108,000	13,000
Monarch	Wyo	Tongue	Auth. 1950	213,000	17,000
Buffalo	Wyo	Clear Creek	Auth. 1950	572,000	128,000
Greybull	Wyo	Big Horn	Auth. 1950	660,000	60,000
Glasgow	Mont	Milk	Completed	17,000	8,000
Saco	Mont	Bear Creek	Inactive	77,000	3,500
Harlem	Mont	Milk	Planning	75,500	20,000
Havre	Mont	Milk	Planning	2,075,000	125,000

APPENDIX B—*Bureau of Reclamation Construction Units*

Construction Unit	Stream	Status Jan. 1, 1952	Storage (Acre-Feet)	Acres to be Irrigated [1]	Estimated Cost [2]
Missouri River Basin Project [3]					
Big Horn Basin Div., Wyo.:					
Owl Creek Unit	Owl Creek	Preconst.	17,300	18,000	$3,388,000
Big Horn Unit	Bighorn	Preconst.	None	3,200	1,441,000
Bluff Unit	Bighorn	Preconst.	None	1,200	555,000
Hanover Unit	Bighorn	Preconst.	None	6,200	2,401,000
Paintrock	Paintrock Cr	Preconst.	7,600	7,000	1,629,000
Shell Creek Unit	Shell Creek	Preconst.	15,000	6,600	4,782,000
Shoshone Extensions Unit		Preconst.	280,000	95,400	42,666,000
Boysen Div., Wyo.: Boysen Unit	Bighorn	Under Const.	970,000	[4] 100,000	34,321,000
Cannonball Div., N. Dak.: Cannonball Unit	Cannonball	Preconst.	243,000	12,500	12,622,000
Cheyenne Div., Wyo.-S. Dak.:					
Angostura Unit	Cheyenne	Under Const.	160,000	12,150	13,513,000
Keyhole Unit	Belle Fourche	Under Const.	340,000	55,700	4,350,000
Rapid Valley Unit		Preconst.	114,700	14,200	8,948,000
Grand Div., S. Dak.: Shadehill Unit	Grand	Under Const.	358,000	12,000	10,690,000
Heart Div., N. Dak.:					
Dickinson Unit	Heart	Under Const.	16,500	900	1,631,000
Heart Butte Unit	Heart	Under Const	225,500	13,100	5,710,000

See footnotes at end of table.

APPENDIX B—*Bureau of Reclamation Construction Units*—Continued

Construction Unit	Stream	Status Jan. 1, 1952	Storage (Acre-Feet)	Acres to be Irrigated [1]	Estimated Cost [2]
Missouri River Basin Project [3]—Con.					
Helena-Great Falls Div., Mont.:					
Canyon Ferry Unit	Missouri	Under Const.	2,051,000	[4] 506,000	$29,430,000
Helena Valley Unit		Preconst.	None	21,100	4,588,000
James Div., S. Dak.: Oahe Unit	James	Preconst.	848,000	750,000	216,108,000
Jefferson Div., Mont.: East Bench Unit	Beaverhead	Preconst.	204,000	39,500	20,130,000
Lower Big Horn Div., Mont.-Wyo.:					
Yellowtail Unit	Bighorn	Preconst.	1,375,000	None	99,586,000
Hardin Unit	Bighorn	Preconst.	None	45,800	11,892,000
Marias Div., Mont.: Lower Marias Unit	Marias	Preconst.	1,357,000	127,000	60,250,000
Missouri-Souris Div., Mont.-N. Dak.:					
Jamestown Unit	James	Under Const.	230,000	22,000	10,769,000
Missouri Diversion Unit	Missouri	Preconst.	49,000	105,000	102,213,000
Crosby Mohall Unit		Preconst.	473,000	1,000,000	265,953,000
Devils Lake Unit		Preconst.	595,000	22,000	21,023,000
Montana Pumping Div., Mont.:					
Charley Creek Unit	Missouri	Preconst.	None	800	249,000
Nickwall Unit	Missouri	Preconst.	None	2,800	780,000
Moreau Div., S. Dak.: Bixby Unit	Moreau	Preconst.	215,000	undetermined	13,064,000
North Dakota Pumping Div., N. Dak.:					
Fort Clark Unit	Missouri	Under Const.	None	2,100	603,000
Hancock Flats Unit	Missouri	Preconst.	None	5,400	1,446,000
Painted Woods Unit	Missouri	Preconst.	None	4,300	1,149,000
Square Butte Unit	Missouri	Preconst.	None	1,900	395,000
Powder Div., Mont.-Wyo.:					
Kaycee Unit	Powder	Preconst.	171,500	17,000	10,080,000
Moorhead Unit	Powder	Preconst.	1,150,000	58,000	25,530,000
Piney Unit	Powder	Preconst.	17,600	9,600	2,475,000
Three Forks Div., Mont.: Crow Creek Unit	Missouri	Preconst.	None	5,000	1,542,000
Yellowstone Div., Mont.-N. Dak.:					
Cartwright Unit	Yellowstone	Preconst.	None	800	282,000
Sadie Flat Unit	Yellowstone	Preconst.	None	7,000	2,189,057
Savage Unit	Yellowstone	Completed	None	2,200	504,000
Sidney Unit	Yellowstone	Preconst.	None	1,900	711,000
Colgate Unit	Yellowstone	Preconst.	None	1,300	449,000
Elm Coulee Unit	Yellowstone	Preconst.	None	1,800	495,000
Seven Sisters Unit	Yellowstone	Preconst.	None	4,300	1,418,000
Stipek Unit	Yellowstone	Preconst.	None	4,800	1,616,000
Marsh Unit	Yellowstone	Preconst.	None	3,200	1,002,000
Bostwick Div., Nebr.-Kans.	Republican	Under Const.	[5] 940,000	89,390	47,930,000
Frenchman-Cambridge Div., Nebr.	Republican	Under Const.	423,400	68,570	66,577,000
Oregon Trail Div., Wyo.:					
Glendo Unit	N. Platte	Preconst.	800,000	.....	42,073,000
Kortes Unit	N. Platte	Under Const.	5,000	None	13,852,000
Smoky Hill Div., Kans.: Cedar Bluff Unit	Smoky Hill	Under Const.	377,000	11,500	17,576,000
South Platte Div., Colo.: Narrows Unit	S. Platte	Preconst.	700,000	260,000	39,310,000
Upper Republican Div., Colo.-Kans.: St. Francis Unit.	S. Fork, Republican.	Under Const.	175,000	6,500	15,013,000

See footnotes at end of table.

APPENDIX B—*Bureau of Reclamation Construction Units*—Continued

Construction Unit	Stream	Status Jan. 1, 1952	Storage (Acre-Feet)	Acres to be Irrigated [1]	Estimated Cost [2]
Missouri River Basin Project [3]—Con.					
Middle Loup Div., Nebr.:					
Farwell Unit	Middle Loup	Preconst	55, 000	52, 300	$28, 519, 000
Sargent Unit	Middle Loup	Preconst		17, 375	11, 163, 000
Solomon Div., Kans.:					
Kirwin Unit [6]	N. Fork, Solomon	Under Const	315, 000	10, 000	24, 037, 000
Glen Elder Unit [6]	Solomon	Preconst	900, 000	26, 000	42, 230, 000
Webster Unit [6]	S. Fork, Solomon	Preconst	327, 000	8, 500	22, 802, 000
Sandhills Div.: Ainsworth Unit	Snake	Preconst	70, 000	44, 800	19, 510, 700
Transmission Div		Under Const			307, 571, 000
Operating Reclamation Projects					
Belle Fourche, S. Dak	Belle Fourche	Completed	192, 000	55, 700	5, 039, 000
Buford Trenton, N. Dak	Missouri	Completed	None	11, 000	940, 535
Riverton, Wyo	Wind	Under Const	183, 600	98, 000	24, 405, 000
Shoshone, Wyo	Shoshone	Under Const	442, 000	88, 500	21, 476, 500
Huntley, Mont	Yellowstone	Completed	None	32, 500	1, 559, 200
Intake, Mont	Yellowstone	Completed	None	800	92, 371
Buffalo Rapids, 1st Div., Mont	Yellowstone	Completed	None	15, 000	2, 680, 000
Buffalo Rapids, 2d Div., Mont	Yellowstone	Completed	None	12, 000	2, 455, 000
Lower Yellowstone, Mont	Yellowstone	Completed	None	57, 000	3, 638, 811
Milk River, Mont	Milk River	Completed	397, 150	127, 000	9, 571, 000
Sun River, Mont	Sun River	Completed	185, 850	96, 800	9, 706, 000
Colorado-Big Thompson	[7]	Under Const	995, 640	615, 000	160, 068, 000
Kendrick	N. Platte	Under Const	1, 215, 000	20, 000	30, 774, 000
North Platte	N. Platte	Complete	1, 190, 000	[8] 363, 600	[9] 27, 726, 000
Mirage Flats	Niobrara	Complete	31, 300	12, 000	3, 222, 588

[1] New and supplemental.

[2] Department of Interior estimates of appropriations, fiscal year ending June 30, 1953.

[3] Units under construction or in preconstruction stage.

[4] Major conservation storage facility.

[5] Includes 850,000 AF storage in Harlan County (Corps of Engineers) Reservoir.

[6] Storage Capacities and Costs based on June 1952 estimates.

[7] Transmountain Diversion from Colorado River to South Platte.

[8] Includes lands irrigated under the Warren Act.

[9] Includes $8,175,000 for rehabilitation and betterment.

APPENDIX C—*Missouri Basin Power Plants*

[Authorized to Jan. 1, 1952]

Plant	State	Stream	Date Auth.	No. and Size of Units (KW)	Ultimate Install. (KW)
Corps of Engineers					
Fort Peck	Mont.	Missouri	1938	[3] 1/15,000 2/35,000	185,000
Garrison [1]	N. Dak.	Missouri	1944	5/80,000	400,000
Oahe [1]	S. Dak.	Missouri	1944	5/85,000	[5] 425,000
Big Bend	S. Dak.	Missouri	1944	6/20,000	120,000
Fort Randall [1]	S. Dak.	Missouri	1944	8/40,000	320,000
Gavins Point	Nebr.	Missouri	1944	3/33,300	100,000
Harlan County [1]	Nebr.	Republican	1944	1/1,200	1,200
					1,551,200
Bureau of Reclamation					
Canyon Ferry [1]	Mont.	Missouri	1944	3/16,667	50,000
Kenil	Mont.	Marias River Canal	1944	2/800	1,600
Lyon	Mont.	Madison	1946	3/8,000	24,000
Absaroka	Mont.	Yellowstone	1946	3/16,667	50,000
Little Porcupine	Mont.	Missouri	1944	3/6,000	18,000
Portage	Mont.	Missouri	1946	2/10,000	20,000
Tiber	Mont.	Marias	1944	3/667	2,000
Yellowtail	Mont.	Big Horn	1944	4/50,000	200,000
Moorhead	Mont.	Powder	1944	2/4,000	8,000
Crosby	N. Dak.	Mo. Diversion	1944	6/8,000	48,000
Des Lacs	N. Dak.	Mo. Diversion	1944	6/10,000	60,000
Angostura [2]	S. Dak.	Cheyenne	1944	1/1,200	1,200
Pony Hills	S. Dak.	Mo. Diversion	1944	4/45,000	180,000
Sunlight	Wyo.	Sunlight Creek	1946	2/10,000	20,000
Bald Ridge	Wyo.	Clarks Fork	1946	3/10,000	30,000
Hunter Mt.	Wyo.	Clarks Fork	1946	2/6,000	12,000
Thief Creek	Wyo.	Clarks Fork	1946	3/20,000	60,000
Tongue River	Wyo.	Tongue	1946	2/12,500	25,000
Heart Mountain [2]	Wyo.	Shoshone	1945	1/5,000	5,000
Shoshone [2]	Wyo.	Shoshone	1904	1/4,000 2/800	5,600
Boysen [1]	Wyo.	Big Horn	1944	2/7,500	15,000
Pilot Butte [2]	Wyo.	Wind	1918	2/800	1,600
Guernsey [2]	Wyo.	North Platte	1925	2/2,400	4,800
Lingle [2]	Wyo.	North Platte	1903	2/400 2/300	1,400
Seminoe [1]	Wyo.	North Platte	1935	3/10,800	32,400
Kortes [2]	Wyo.	North Platte	1944	3/12,000	36,000
Alcova [1]	Wyo.	North Platte	1937	2/18,000	36,000
Big Thompson	Colo.	Colo. River Div.	1937	1/6,700	6,700
Estes [2]	Colo.	Colo. River Div.	1937	3/15,000	45,000
Flatiron	Colo.	Colo. River Div.	1937	2/31,500	63,000
Mary's Lake [2]	Colo.	Colo. River Div.	1937	1/8,100	8,100
Pole Hill	Colo.	Colo. River Div.	1937	1/33,250	33,250
Green Mountain [4]	Colo.	Blue	1937	2/10,800	21,600
Total, Bureau of Reclamation					1,125,250
TOTAL, BASIN					2,676,450

[1] Plant under construction. [2] Plant completed. [3] Now operating.
[4] Feature of Colorado Big-Thompson Project located in Colorado River Basin. [5] Tentative.

APPENDIX D—*Population of the Missouri Basin, 1920–1950*

[*The population figures for each State include only that portion of the State lying within the Missouri River Basin*]

State	1920	1930	1940	1950
Colorado	495, 883	565, 528	625, 486	795, 694
Iowa	804, 343	808, 667	800, 304	767, 623
Kansas	1, 138, 969	1, 186, 594	1, 139, 426	1, 178, 348
Minnesota	81, 786	82, 887	88, 604	88, 973
Missouri	1, 666, 212	1, 732, 313	1, 734, 094	1, 764, 463
Montana	451, 619	436, 801	439, 513	453, 658
Nebraska	1, 296, 372	1, 377, 964	1, 315, 834	1, 325, 510
North Dakota	373, 906	397, 763	360, 242	345, 771
South Dakota	636, 547	688, 832	642, 971	652, 740
Wyoming	161, 049	185, 787	208, 089	246, 731
Total	7, 106, 686	7, 463, 136	7, 354, 563	7, 619, 511

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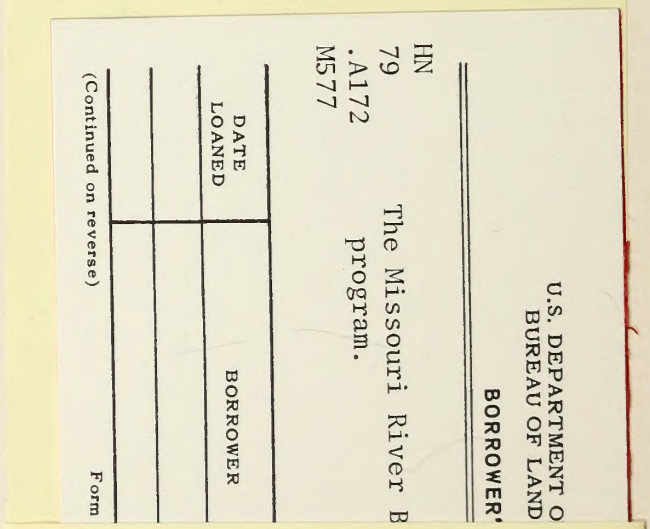
Library
Bldg. 50, Denver Federal Center
Denver, CO 80225



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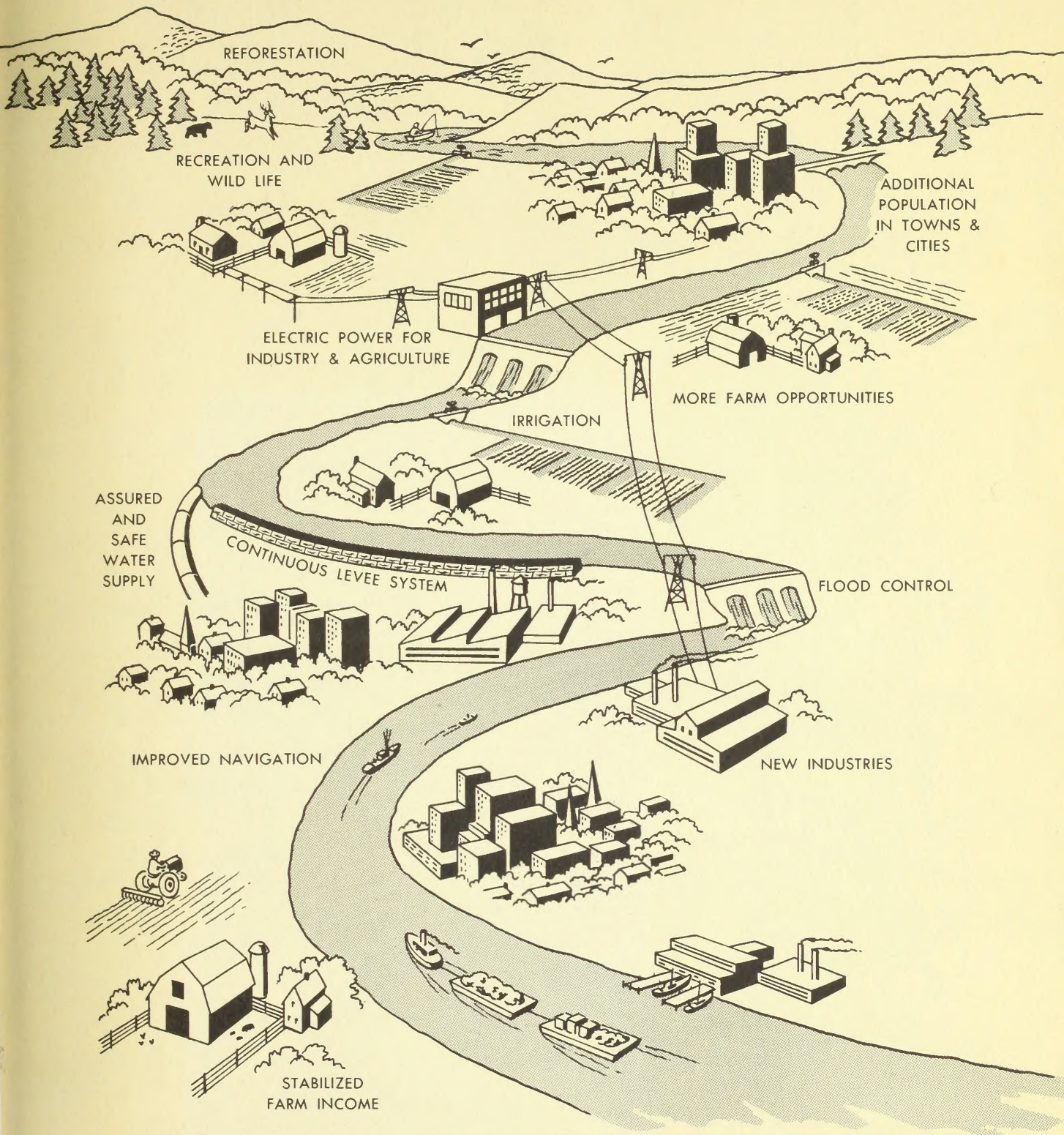
Bureau of Land Management
Library
Denver Service Center

A RIVER AT WORK



CONTROLLED, a river is productively at work for the benefit of man.

BIRTHPLACE OF THE MISSOURI, THREE FORKS, MONTANA